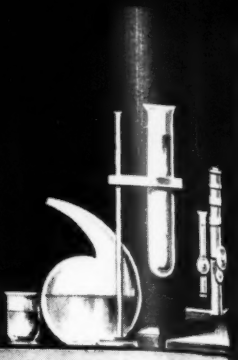
DECEMBER 1941

An Important "Clepo" Contribution



A NEW DEGREASING SOLVENT
FOR CIVILIAN AND DEFENSE MANUFACTURING

SIMPLE DIP PROCESS
15 SECONDS
NO HEAT NECESSARY

WRITE FOR FURTHER INFORMATION

NO OBLIGATION WHATSOEVER

THERE IS NO TIME TO LOSE

CLEPO — CLEANING COMPOUNDS

FREDERICK GUMM CHEMICAL COMPANY, INC.
538-542 FOREST ST., KEARNY, N. J.

Western Distributor: BELKE MFG. CO., 947 N. Cicero Ave., Chicago, Ill.

The MONTHLY REVIEW

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AMERICAN ELECTROPLATERS' SOCIETY, INC.

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93 Oak Grove Ave.
Springfield, Massachusetts

VOL. XXVIII DECEMBER 1941 NO. 12

A Merry Christmas
and a Prosperous
Happy New Year
For Everyone

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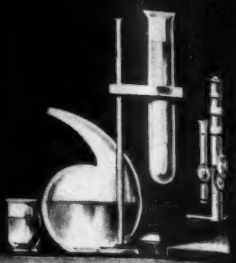

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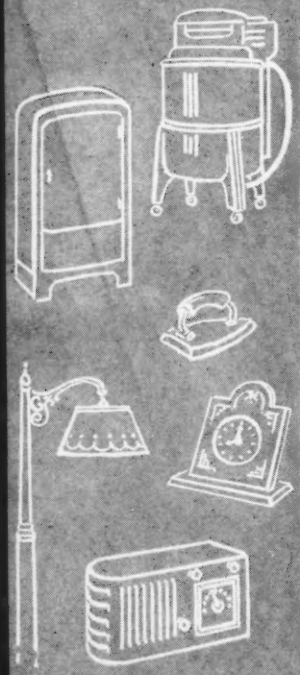

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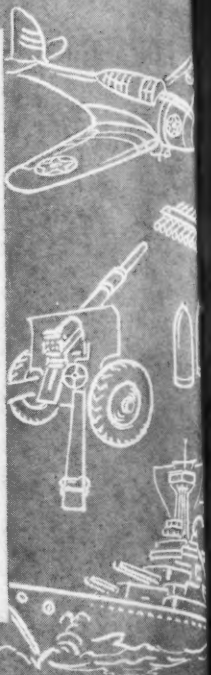

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Merry Christmas
FROM
GRAND RAPIDS
Your 1942 Convention City

"Information Please" Program

Newark Branch Meeting, October 17, 1941

(Several Branches have conducted "Information Please" programs with marked success. The following direct report of the one held at the Newark Branch meeting contains much practical plating information from men who should and do know the problems in the metal finishing field. Mr. Louis Donroe was Master of Ceremonies; the experts were Dr. Walter Meyer, Editor of *Metal Finishing*, Mr. Gustave Klinkenstein of Maas and Waldstein, and Mr. Adolph Bregman, Consultant. We believe that this type of Educational Program is unquestionably well worth while. — Ed.)

Mr. Donroe: What is the accepted method for preparing zinc and zinc castings for silver plating?

Dr. Meyer: I have had experience on silver plating of zinc and zinc castings and it is obvious from the metallurgy of zinc, and the chemistry of zinc, that it would be difficult to deposit silver directly upon it. The best way that I have found of silver plating on zinc, as well as on zinc base die castings, is to copper plate using the cyanide copper bath, observing the precautions in cleaning and in acid dipping that you ordinarily do when preparing the metal for copper plating when you have to subsequently nickel plate. It would involve copper plating and then silver plating.

Mr. Donroe: How can racking costs best be determined?

Mr. Bregman: Racking costs are something that I have never seen segregated in any shop. If that problem is present, I would start out by, first, studying the shape of the article and determining the best type of rack to use. For plating purposes, regardless of the cost of the rack I would personally recommend not trying to build the cheapest rack but the best rack.

The job would then have to be faced from the point of view of how many pieces could be racked by a boy, unskilled, of the lower bracket wages in the shop, presumably starting at not less than 30¢ an hour. Using that class of labor because you cannot afford to use higher paid labor on that class of work, estimate the number of pieces that such a boy could put on the rack in an hour. The rest is simply paper work: dividing the cost by the number of pieces, you have the cost per piece. I want to add that it should be carefully checked by a trial run.

Mr. Donroe: Is it possible to establish a more or less uniform cost per square foot for polishing metals?

Mr. Bregman: I think it is theoretically possible but practically not very advisable. The cost of polishing depends upon the shape of the article and the complexity of the contour of the piece. It depends on the conditions of the base metal and it depends upon the final finish desired.

I would hesitate to set any figure for polishing on a square foot basis. The method that I found best in practice (although it is not supposedly scientific) is to judge the piece first and see how many wheel operations it will take to cut it down before the first plating operation, then the necessary buffing operations that will follow with or without a bright nickel and the final buffing operation, and estimate the number of pieces that can be done per hour per each operation. I would like to say finally that that estimate should never be made final and set up as a definite inflexible figure without being checked by a trial run of a sufficient number of pieces: 100, 200, or 500, as the case may be.

Mr. Donroe: What is the nature of the ingredients in aluminum paints or similar materials used for the protection of exhaust manifolds in the aeronautical industry?

Mr. Klinkenstein: That type of paint, namely, an aluminum paint that must be of such nature that it will retain its aluminum appearance after being subjected to high temperatures is made up obviously using a fine grade of aluminum leaf. The vehicle is of such nature that on being subjected to the high heat it volatilizes and does not carbonize, or it does not sheer. In other words it leaves a film. At highest heat you have got substantially an aluminum oxide deposit on the surface most of which has been volatilized.

Mr. Bregman: I would like to know if Mr. Klinkenstein is familiar with an aluminum coating material which came out about 5 or 6 years ago. It was patented by a man named Preston Davey and his claim was that the vehicle was of such nature that it left behind, after heat treatment, a bituminous residue which acted as a filler preventing pores, pits, or what have you, and resulted in a higher corrosive protection than others of similar nature.

Mr. Klinkenstein: I don't know the exact paint you are talking about but I think I can guess at it. There are certain alumi-

num paints on the market that in contact with heat leave a bituminous residue and give a finish that is fairly corrosion resistant.

Mr. Donroe: Has there been any further work done with the problem of hydrogen absorption relative to electroplated surfaces?

Dr. Meyer: There has been recently published, some very important contributions to the subject of hydrogen embrittlement. The writer translated an article by Fischer and Barmann from *Zeitschrift fur Metallkünde*, and the translation was published in the September issue of *Metal Finishing*. In addition, an excellent article on this subject just appeared in the November 27, 1941 issue of *The Iron Age*. This article discusses embrittlement from the Bullard-Dunn process, cadmium plating, tin plating and various other plating baths and metal treating processes.

Some conclusions in regard to embrittlement are as follows:

1. Embrittlement from zinc cyanide plating is worse than cyanide cadmium plating.
2. Acid zinc plating embrittles only slightly and considerably less than cyanide cadmium or zinc plating.
3. Susceptibility to embrittlement increases with the hardness of the steel and the carbon content.
4. Embrittlement tends to be relieved somewhat at room temperature but usually not sufficiently for safety's sake.
5. Heating from 300 to 500° F. in air is more effective than heating at the same temperature in oil.
6. Electrocleaning does not contribute much to hydrogen embrittlement but considerable embrittlement can take place during pickling.

Question: Did you say that the hydrogen caused embrittlement of the steel or of the finished article?

Dr. Meyer: Embrittlement is in the steel. A very small amount of hydrogen will be absorbed by the zinc.

Mr. R. Sizelove: After you once get a film of zinc on the steel how does the hydrogen affect it?

Dr. Meyer: The important factor, Bob, in that case is that zinc coatings are not impervious to hydrogen. Coatings from cyanide zinc solutions are less permeable to hydrogen than those

from acid solutions and, therefore, the coating of zinc does not prevent the penetration of the hydrogen to the steel below, and a considerable thickness of zinc is necessary to effect complete masking of the hydrogen from the steel.

Mr. Donroe: Why is a zinc chromate primer recommended? Is not the anodic coating sufficient?

Mr. Klinkenstein: Experience has shown that an anodic treated aluminum is probably quite resistant by itself but if there are previous marks where the anodic process has been destroyed or the results of the plating have been destroyed, the zinc chromate primer acts as an inhibitor to further corrosion that will take place. The zinc chromate primer is used primarily to further pacify the entire surface as a sort of general insurance that the anodized process is completely protected where there has been a failure in the anodizing process. The zinc chromate primer passivates the entire surface and helps to maintain a corrosive-free condition under any subsequent finish or if the anodized surface is left without any further finish.

The thickness of the film is 1/100,000 of an inch and as little as 1/500,000 of an inch and that means it is very thin and rather easily broken through, so you can see the necessity for the zinc chromate primer.

Mr. Donroe: What development of the metal finishing industry was most outstanding within the past two years?

Dr. Meyer: There are two and possibly three outstanding developments. I will start by naming one: Corronizing. Corronizing is a process for applying a nickel coating to steel and upon the nickel is subsequently applied a zinc or tin coating. Therefore, it is a method of applying tin or zinc upon the nickel. The reason why it is outstanding is that it gives us a method of applying an inert coating in a relatively non-permeable condition.

When the zinc is alloyed with the nickel by heat treatment, the pores in the nickel coating appear to be closed, thus giving a relatively non-permeable coating. Corronizing has been applied successfully to such objects as thermostats, fly screen, oil cans, wire and oil well equipment.

Question: How does it compare with Sherardizing?

Dr. Meyer: Sherardizing is applied by rolling iron in zinc dust at temperatures from 450 to 700° F. These coatings protect

the iron sacrificially whereas the Corronized coatings protect the zinc largely mechanically.

Question: How heavy a Corronizing deposit is made?

Dr. Meyer: 0.2-0.3 mil. The information given in a paper published recently is in millionths of an inch. 2/10 mil. coating stood 140 hours salt spray. 2/10 mil. nickel would stand 2 hours salt spray.

Question: Can the Corronizing process be applied to polished surfaces?

Dr. Meyer: If the Corronized coating is subsequently polished or buffed, some of the alloy zone will be removed and the corrosion resistance of the coating impaired, and thus I doubt whether Corronizing will be suitable for highly buffed surfaces.

Mr. Bregman: While Dr. Meyer has been talking I have had time to think and I would like to mention two developments that are equally important to the plating industry. One is the thing that we have heard about constantly through rumors and general reports, but on which we have had few details, and that is electroplating steel with tin instead of hot-dip tinning as they are doing in the sheet mills now. I am unable to give you details at this time. As a matter of fact a statement to this effect was made two or three weeks ago at the Iron and Steel Society meeting in the west. I personally feel that process will spread the use of electroplating more than any one other that has come up in some time past.

The second development that I consider of great importance is the development of the rectifier for electroplating. This has been on the market commercially for practical working conditions for a couple of years anyway.

I might say on that quick tin deposit on steel in canning that in making cans they have found a lot of trouble with their dies and had to change many dies in trying to use that material.

Question: In soldering cans I believe they do not use a flux and on some they do. Can you explain this?

Mr. Bregman: I have seen some of the beer cans made. They did not use a flux at all. Flat sheets travel along, then go through solder and is wiped off as they come through.

Mr. Klinkenstein: On finishing materials and methods of application, I think that the outstanding development in the last year has been the extremely fast baking materials based on the

use of formaldehyde and the practical application and use of this material in conjunction with infra red baking. This material and application has reduced baking time in finishing shops anywhere from periods of an hour to 6 or 10 minutes so that from the standpoint of speed and economy, that type of material (the urea formaldehyde) has probably been of the greatest use to the finisher and to the user of finishing materials; although extremely quick curing material was baked with infra red rays so that the quick curing could be accomplished effectively. That I feel is the greatest advance for the plater or the man who uses finishing materials.

Dr. Meyer: In applying infra red baking to reflectors I am told that gold has not proved to be as suitable a reflecting surface as aluminum, particularly a vacuum deposited aluminum, because alloying was experienced during the heating of the gold and naturally you could not put enough on to overcome diffusion entirely. Is this true?

Mr. Klinkenstein: It is true. Particularly in the sealed beam or completely enclosed type of reflectors. The heat in sealed reflectors reaches a very high temperature. The gold plated reflector breaks down after a short period. The aluminum reflector has now been received with greater favor, particularly where it has been fused on in a vacuum process and has given the best service under high temperature conditions. The efficiency at the outset is not as great as the gold plated reflector but the efficiency over long periods of service is much greater with aluminum than with gold.

Mr. Bregman: Infra red baking prompts me to ask a question. Have there been any recent developments in baked finishes that will withstand solvents such as carbon tetrachloride or trichlorethylene?

Mr. Klinkenstein: Is it for a protective coating primarily or enameling and protection?

Mr. Bregman: Both.

Mr. Klinkenstein: You can get a finish that is resistant to practically any solvents under ordinary temperatures but I can see difficulty if carbon tetrachloride or tri-chlorethylene is applied at boiling point as a vapor condition will cause softening. But in contact with solvents at normal or room temperatures, this of course would not be so.

Mr. Bregman: Going back to rack costs, it occurred to me that I had omitted to note one or two very important facts in figuring your costs of racking. First, of course, is the cost of the rack which must be prorated and amortized over the life of the job. Let's take an example. A job shop has a job in which 10,000 pieces have to be put through. The cost of racking is passed on if you figure cost of allowance and amortize this over 10,000 pieces or on such quantity as will come through on such a job. The rack will then be a present from the customer to you.

The second item is the cost of installation of this rack and you must confine this to the proven cost for such a job. Consider your labor and make a substantial provision for the materials involved.

Question: What quantitative methods are available for measuring adhesion of plated coatings?

Dr. Meyer: The only apparently satisfactory method to date is that proposed by Ollard and modified by Roehl. The test involves plating a ring with a metal to be studied and the force required to push the coating off the ring by a plunger gives a measure of the adhesion.

Mr. Mullen: What is the best method of putting a heavy silver plate on steel? One man puts a silver strike on and then silver plate, and another man puts a copper flash and then silver plate. Still another man puts a copper flash, then a silver flash and silver plate.

Dr. Meyer: The method to be used would depend upon the plating conditions and the shape of the object. The use of the copper flash and silver flash deposits is to obviate plating by immersion and if the object is of simple shape, it may be possible to dispense with them providing the work can be struck in the plating solution at a sufficiently high current density.

Question: Should not a little silver be used in a silver strike?

Mr. Horace Smith: Most of them plating silver directly on steel are using a high percentage of cyanide, 10 oz. to the gallon. When this hydrogen is created it boils high and deposits a very thin coating of silver on your steel. It is forced right on. It will do the same thing with lead, and heavy metals. You can strike in that strike and into your regular strike and plate in any solution; it will not come off. The work is clean if you strike it right.

Question: How about the man who strikes it in a plating bath — one bath. After a couple of seconds he puts it back in again.

Mr. Mullen: This is seldom done. It will stick if metal is clean. In chrome plating shafts they come in the plating room with a nice finish. We plate in chromium 20 to 30 minutes and when they come out they have grinding stripes in them. We get rejections for rough plate. Where did the roughness come from? The initial grinding operations were on an extremely coarse grit. Maybe an 80, and then they jumped to 220 to finish it. They are grinding it smooth, but they are not burnishing it smooth, and when we plate the scratches appear. Cut out rough grinding in initial stages and in that manner the direction of your scratches on subsequent operations can be burnished out.

Question: With all these gentlemen expert in silver plating, who knows but what the gas action causes a coating adherence on a real clean surface.

Dr. Meyer: The purpose of the strike is to raise the discharge potential of your silver to prevent the chemical displacement of silver.

There is no reason why you could not deposit a silver plate directly upon copper. Many people do not use a silver strike when plating on copper. The silver solution gives fairly good results depending, of course, upon the shape of the object. With a very irregularly shaped object you probably have to strike. One purpose of it is the uniform distribution of silver over the irregularly shaped surface. You could probably get away without a strike on a simple shape.

As for plating silver upon copper and nickel, it would depend upon the type of work being done. It would be silly to nickel plate unnecessarily as the cost of nickel plating is high and the deposit oxidizes fast. There is poorer adherence when silver is put on nickel than silver on copper. You get excellent results by copper plating and silver plating promptly upon the copper.

Question: Another development is organic finishing. In the last two or three years organic finishing has become widespread. We have continued to use quick drying material, using urea formaldehyde types and indirect baking. It is rather difficult today to procure these materials. I was wondering if there would be any suggestions from those people who were not con-

cerned in defense work or indirectly in defense work on materials they could use today which would dry in that short a period of time and still give them the quality that the other materials did. Formaldehydes have been exploited widely and wonderful work accomplished with them. Today we see a restriction on its availability to the point where it is probably down to 30 or 40% unless it is on direct priority work. Then the solvents that come with it are in a bad condition today. However, its use has been built up so that from the standpoint of tonnage it is more available than a few years ago.

Mr. Klinkenstein: As a partial answer to this problem, lacquers have been developed that have color retention so that substantial air drying coatings can be baked at temperatures as high as 250°F. anywhere from 15 minutes to ½ hour. They give excellent color, adhesion and color retention and are a partial solution of this problem.

Mr. Donroe: Of all metals which is the most difficult to enamel without surface preparation?

Mr. Klinkenstein: I would say probably chromium and you can put nickel in the same class, but with the right type of coating carefully selected any metal surface can be properly coated particularly where the finish is going to be baked after application. I think today we can safely say that no metallic surface is impossible of being properly coated.

Mr. Donroe: Can the Metal Finishing Industry hope for a lessening of restrictions of necessary materials for production?

Dr. Meyer: I refer you to the New Haven talk by Ernest Thum, "Study of the Metal Situation" published in *Metal Progress*. There are no bright spots. Within the next two years there is absolutely no hope of improvement in any metal that I can think of. The general picture is that it might be worse. There is some question in people's minds as to whether the metals that are being restricted, so to speak, are not being hoarded by Government Agencies rather than by people. It is rather commonly believed, and known to some extent, that in production for Defense many companies think they have to have a full year's supply of materials on hand before they can begin operating. Thus, large quantities of metals have been tied up for that purpose.

Mr. Bregman: I second everything that Dr. Meyer has said. Another strange fact is that a short while back one of the substitute metals we were urged to use for nickel was copper. At that time the copper picture looked good. Today it looks very bad, with a prospective shortage in the coming year of about 300,000 tons, after, however, we have made provision for all of Defense requirements, for civilian needs, and for export of one-half a million tons a year. We have, however, enough ships to bring it up from Chili in time. However, if we go to war this will not be a simple matter.

Mr. Maguire: The OPM and other people in Washington have begun to realize in the past two months the fact that one of the things that has happened by reason of the Defense program is that small business and even substantially great business are being pushed to the wall. They have agreed that it is a serious situation and they are more than anxious to do something to keep them alive. I personally believe that they will give serious consideration to giving more supplies to smaller industries within the limits possible for Defense in order to keep a large number of firms, and in the aggregate a large number of employees, from suffering due to shut-downs and unemployment. On paper and from all evidence the situation looks decidedly bad but I don't think it will be allowed to go to its limit. That is only a personal impression.

Mr. Klinkenstein: In the metal finishing industry I can only give some of the pessimism that has been expressed by both Dr. Meyer and Mr. Bregman. Alcohol has many uses, but many simple substitutions have been used in the lacquer industry. The best information I can gather is that there will be a shortage in 1941 of 80,000,000 gallons of alcohol. This affects everyone who owns a car and needs an anti-freeze. Other materials will have to be put on the market to take up that deficiency.

What the beginning of the year will bring I would not venture an immediate forecast. If solvents continue short manufacturers are undoubtedly going to turn their production into smokeless powder. Urea formaldehyde is short. Orders have been issued that we may not furnish these materials for certain classes of goods in order to conserve them for Defense needs.

As a whole the outlook for the coming year is very much in doubt. Many materials will be unavailable. We will have to

change the way we use them primarily. We have all been schooled in trying to do our work faster and faster and what is going to happen very shortly is that we are going to slow up and do our work slower and probably the article we will produce will have a changed appearance. We are not going to get the materials, as we know them today, if the shortage continues.

Mr. Maguire: Let's throw some sunshine in this thing. We went through the last war, and what came out of that? Lacquers came out—totally new. Certainly organic material manufacturers have been faced with this problem and are facing it and working on it. I have a hunch that when this present emergency is all over there is going to be another radical change in the organic field and I don't see any reason why we should feel sad about it today.

I also have a hunch that when this whole thing is over we are going to make as big a jump today and in the future as we did during the last war in the use of lacquers. There are finishes available today that cannot be marketed because of the unavailability of materials and which will become perfectly practical finishes when this present stringency of materials is over. We will have available linseed oil, castor oil and certain other materials. Anyway, as the Englishman said, "Somehow we will muddle through." There will be a great many changes—no question about that.

Mr. R. F. Clark: What substitute can I use for methanol to dissolve shellac from settings of diamond stones?

Mr. Klinkenstein: Because organic solvents are unavailable, they are out of the picture. Shellac can be removed by anhydrous alcohol. There are other solvents for shellac but all are on the short list. Alcohol will give you a solubility for the shellac without dulling it. You can dissolve shellac in lime water or a weak alkali.

Mr. Clarke: This won't affect gold or silver?

Mr. Klinkenstein: It is perfectly safe to use and you can dissolve the shellac.

Mr. R. Sizelove: The SPAB are at present continuing an investigation as to the metal stocks, nickel, copper and also alcohol

of every company in the country and key manufacturers are being informed that they will be allowed to hold a 30-day stock in their plants whether on defense or non-defense work. I think this will relieve an awful lot of the metal shortages. I personally know of a manufacturer of bumper parts that has four carloads of copper in stock, which he cannot possibly use in three years. It does not take a lot of cases like that to cause a shortage, and when this situation is relieved we can hope for improvement.

When metals are allocated for priority demands, the remainder will be allocated to non-defense customers who will be given a rating of A-1 to A-10 depending upon which they consider more essential to civilian uses. This is the bright side and I am optimistic about it. The SPAB will help.

Question: Do you think that activated carbons can be used in cyanide solution?

Dr. Meyer: The only cyanide solution I know of where activated carbon has been used to very effective advantage is silver.

Mr. Maguire: Is there any reason why when applying a hot dip solder finish with, say, a 40-60 mixture of tin-lead to steel, that the application of a flash copper plate would assist in the adhesion? The question is would the flashing of the steel with a copper coating help adherence?

Dr. Meyer: It is true that copper seems to alloy more readily with tin than steel does. The diffusion is more rapid.

Mr. Donroe: The alloy effect of your dip metals and copper seems to be the greatest thing to bear in mind. Alloy effects of dip metals with steel are considerably less when the time element is considered. You have to increase your time when you dip steel considerably over the time you have to use for copper.

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Alkaline Tin Plating

By ZACHARY IRENAS
General Instrument Corp.
Elizabeth, N. J.

TIN offers an excellent protective coating on copper, brass and steel. There are three methods of applying this coating; they are hot tinning, deposition by immersion, and electrotinning. The latter may be applied in either alkaline or acid baths. This paper is primarily concerned with the alkaline type plating solution. With the advent of the sodium stannate — sodium acetate type bath, the alkaline type solution has become very popular. This is due to its ease of operation, excellent throwing power, and the uniform adherent coating it deposits. A short review of the chemical and physical properties of tin may help the plater decide to what uses electrotinning may be put. The color of tin is white with a slightly bluish tint. Tin takes on a brilliant luster when highly polished. Small traces of lead, antimony, arsenic, and iron decrease its luster and impart to it a yellowish tinge. The atomic weight of tin is 118.7. Its m.p. is 231.9° C. and its valence is two and four. Tin is a soft metal and, therefore, it is impractical to plate articles which have to withstand wear and tear. On the Moh scale, it shows a hardness of 1.8 as compared with 1.5 for lead and 2.5 for gold.

Electrotinning gives an excellent coating on brass, copper and steel to facilitate soldering. If electrotinned articles are to be stored for a considerable length of time prior to soldering, it is necessary to increase thickness of coating, especially if the condition of storage encourages corrosion. The omnipresent tin can, which is really steel coated with tin, bears witness to the resistance of tin to organic acids present in foods. For the same reason, it is used as a coating for other articles which come in contact with food, such as milk cans, frigidaire trays, etc.

Since tin is below steel in the electrochemical series, it will protect steel to the same degree that nickel will. That is, it has no intrinsic protective value as far as steel is concerned. In other words, the protection that tin affords depends entirely on the porosity of the coating. Pinholes in electroplated tin may be due to suspended matter in solution or precipitated basic salts. Therefore, it is essential to have the plating solution free from all

foreign matter and from any sludge that may have settled on the bottom of the tank.

Before discussing the actual tin plating bath, it may be of interest to know that except for a negligible quantity, all tin consumed in this country is imported. The principal tin producing countries are the Dutch East Indies, the Malay states and Bolivia. The July '41 issue of *Engineering and Mining Journal* reports that Dr. J. B. Mirtie of the U.S. Geological Survey is conducting a four year survey of tin deposits in Alaska. At present, Alaska is producing more tin than all domestic districts combined.

Bath Composition

The alkaline tin plating bath is composed of the following ingredients: sodium stannate, sodium hydroxide, sodium acetate, and hydrogen peroxide. The sodium stannate furnishes the quadrivalent tin ions in solution. The sodium hydroxide increases the conductivity of the bath and helps the corrosion of the anodes. Sodium acetate serves as a buffer, just as boric acid does in a nickel solution. Hydrogen peroxide serves as an oxidizing agent. It oxidizes bivalent tin, which is injurious to a proper tin deposit, to quadrivalent tin. Hydrogen peroxide may be entirely eliminated if the solution is properly maintained and the anode current density carefully watched.

The constituents of the tin bath may vary as follows:

$Na_2SNO.3H_2O$	8-18 oz./gal.
NaOH	1.0-4.0 oz./gal.
NaAc	2-4.0 oz./gal.
H_2O_2	1/16-1/8 oz./gal.

Sodium hydroxide should be determined daily, since its concentration is the most important factor in the tin bath. Too high a concentration of caustic soda will result in rough and spongy deposits. Too low a concentration will result in the anodes being covered with a black, tenacious oxide. This stops their corrosion and depletes the tin ions in the solution.

Cathode and Anode Current Densities

The cathode and anode current densities may vary from 10—40 A/SF, depending on the temperature of the bath and concentration of its constituents. When the anodes are covered with a green film, it is an indication that the bath is functioning

properly and all tin is being dissolved in the stannic state. The anode current density must be carefully controlled. If the anode current density is too low, tin is being dissolved as stannous ion; and stannous ion in solution will yield rough and spongy deposits. If the anode current density is too high, the anodes are coated with a black oxide and their corrosion stops.

The anode current density must be high enough to have the anodes covered with a greenish film. This is called the critical anode current density. The voltage across the bath will then read from 4 — 6 volts. The anode to cathode ratio should be approximately 1 to 1. When the cathode area is small compared to the anode one, a low anode current density will result. This, as already stated previously, will cause the introduction of stannous ions on the solution. When the ratio of the anode surface to the cathode surface is very large, either anodes from the tank should be removed or dummy cathodes used. The importance of maintaining a proper anode current density cannot be emphasized too strongly. The anodes should also have a positive contact to the anode bar.

The tin solution is operated at a temperature of 140° — 176°F. Too low a temperature will result in dark deposits and poor conductivity. Too high a temperature may cause the precipitation of insoluble salts.

The anode and cathode current efficiencies based on quadrivalent tin are between 60% and 90%. Hydrogen is always given off at the cathode and oxygen at the anodes. Sodium oleate or sodium resinate may be used as a foaming agent to prevent vapors from spreading and to prevent particles of the solution from being sprayed on anode and cathode bars. At present, there are no brighteners for the sodium stannate — sodium acetate bath. But since there has been a recent increase in electrotinning, such a brightener will no doubt soon be developed.

Full Automatic Electrotinning Machine in Operation

In our full automatic plating machine, we plate radio condensers and automatic record changer parts exclusively. Some of these parts are such that only an alkaline tin bath is suited for them. No other commercial plating solution would plate in their deep recesses as well and as uniformly as tin does. All of our plating racks are made of brass and are insulated with rub-

ber. The tin that's deposited on the hooks and clips of the racks is melted off periodically with a torch.

The tanks in our automatic plating machine are arranged as follows:

I. Alkaline spray.
II. Reverse electric cleaner.
III. Warm water rinse.
IV. 10% by vol. H_2So_4 with an inhibitor.
V. Spray rinse.
VI. Tin plating tank.
VII. Cold water rinse.
VIII. Hot water.
IX. Hot air drying.

A small pump is attached to the water tank that follows the plating tank. Water from this tank is used to replenish the water of the tinning tank lost by evaporation. The tanks with hot solutions have thermostatic valves to maintain them at the right temperature.

We analyze our tin solution according to the method given by Oplinger in the 1941 Plating & Finishing Guide Book.

We obtain consistently good results by maintaining our plating solution as follows:

$Na_2SnO_3.3H_2O$ 16 oz./gal.
NaOH 1.3 oz./gal.
NaAc 2 oz./gal.
Anode current density—15A/SF
Cathode currenty density—approx. 15A/SF.
Temperature 176° F.

TORONTO-BUFFALO JOINT EDUCATIONAL SESSION

A preliminary committee meeting was held at the Hotel Brock, Niagara Falls, Ontario, Saturday, November 15, to prepare for a joint educational session of the Toronto and Buffalo Branches of the A.E.S. Mr. John Acheson acted as chairman and a tentative date of Saturday, April 18, 1942 was set. It is to be held at the Hotel Brock, Niagara Falls, Ontario, with the ladies attending. An invitation was extended to Rochester Branch to join with us in this session.

The talks will deal with subjects of vital interest today. Dr. C. J. Wernlund of Niagara Falls is in charge of the educational program. The program, advertising and tickets for the Canadian side of the border has Mr. John Acheson as chairman and Allan Byers, W. E. Price, and Arthur Severs assisting; while on the American side of the border W. M. Fotheringham, chairman and William Hart, Ray Kilroy, and Dr. C. J. Wernlund assisting.

A cordial invitation is extended to A.E.S. members to join with us in an enjoyable and profitable meeting. —W. M. FOTHERINGHAM

The Fundamentals *of* Electrochemistry *and* Electrodeposition

V. Quantity of Electricity and Faraday's Laws

By SAMUEL GLASSTONE
Ph. D., D. Sc.
Frick Chemical Laboratory
Princeton, N. J.

Quantity of Electricity

IN the previous article it was seen that the strength of the current (amps.) flowing through a solution depends on the applied E.M.F. (volts) and on the resistance (ohms) of the solution. In addition to the current strength there is another property of importance in electroplating; this is the *quantity of electricity*. The quantity of electricity passing through a given conductor is measured by the product of the current in amps. and the time in seconds for which the current is passed. The unit of quantity of electricity is the *coulomb*, which is defined as a current of 1 amp. flowing for 1 second. For example, if a constant current of 12.5 amps. is passed through a particular solution for a period of 3 hours 40 minutes, the quantity of electricity in coulombs may be derived in the following manner. The time is first converted into minutes, i.e., 220 mins., and then into seconds, i.e., $220 \times 60 = 13{,}200$ secs.; this is now multiplied by the number of amps., i.e., 12.5, giving as a result $12.5 \times 13{,}200 = 165{,}000$ coulombs.

Faraday's Laws

When a source of E.M.F. is applied to the two electrodes, anode and cathode, of an electrolytic bath containing the solution of a salt of a metal, such as nickel sulfate, two important points will be noted. In the first place, metallic nickel will be observed to be deposited on the negative electrode (cathode) while, in the second place, the positive electrode (anode) will be seen to be dissolving. The amount of nickel which deposits on

the cathode or dissolves from the anode is determined by the quantity of electricity that has passed; it is for this reason that the quantity of electricity is important in electroplating. The rules giving the relationship between the amount of metal deposited or dissolved and the number of coulombs that have passed were first derived by Faraday in 1833, and hence they are generally known as *Faraday's laws*. For simplicity, these laws may be summarized in the following statement: the weight of metal deposited at the cathode or dissolved from the anode is proportional to the quantity of electricity (that is, the current and the time) and to the chemical equivalent weight of the metal. Thus, if a current of I amps. flows for t secs., the weight of metal of equivalent weight e, that is deposited or dissolved will be equal to $\frac{I \times t \times e}{F.}$, where the proportionality constant has, for convenience, been represented by $1/F$.

Atomic Weight and Equivalent Weight

Before considering the question of the value of the constant F, reference must be made to the quantity known as the equivalent weight (e). Since the atom of any element is a definite entity, it must have a definite weight; this weight is, of course, too small to be determined directly, but it is possible to find the weight of any atom with respect to the weight of an atom of hydrogen, the lightest known atom. The number so obtained is known as the *atomic weight* of the element under consideration, the value for hydrogen being unity. The atomic weights of all the common elements are known accurately, and the results are to be found tabulated in textbooks of general chemistry, etc. (The interpretation of atomic weights given here differs somewhat from that employed in practice; it is more convenient to take the atomic weight of oxygen as 16.000. On this scale hydrogen has an atomic weight slightly greater than unity, namely 1.008.)

The *equivalent weight* of an element is equal to the atomic weight divided by the *valence* of the element. For our purpose

it is really the valence of the ion which will be employed, and this is equal to the number of charges carried by the ion discharged at the cathode or formed at the anode. For most ions, the valence is a definite number about which there is no uncertainty; for example, the valence of the nickel ion (Ni^{++}), iron (ferrous) ion (Fe^{++}) and of the cobalt ion (Co^{++}) is two in each case. The valence of silver (Ag^{+}) is one, and of cadmium (Cd^{++}) and zinc (Zn^{++}) ions it is two, irrespective of whether the metal is present in solution as a simple ion or as a complex cyanide. Some metals, however, particularly copper and tin among those used in electroplating, present a problem, because they can be deposited from ions of different valence from different solutions. For example, the simple salts of copper, such as copper sulfate in an acid copper bath, contain copper in the cupric ion (Cu^{++}) form with a valence of two, but in the complex cyanide solution, frequently used in electroplating, the metal is present in the cuprous (Cu^{+}) form and the valence is unity. The equivalent weight of copper in the sulfate solution is thus equal to the atomic weight divided by two, but in the cuprocyanide solution it is the same as the atomic weight. It should be pointed out that the change in valence of copper is not primarily due to the formation of complex ions, but to other circumstances. For example, the complex copper-pyrophosphate bath employed for the bright plating of copper contains the metal in the form of a complex cupric ion with a valence of two. The element tin can also be deposited from ions in two different valence states. In the acid sulfate bath the tin exists in the stannous form (Sn^{++}) and its valence is two; on the other hand, the valence is four in the alkaline stannate bath.

The Faraday

If A is the atomic weight of a metal and v is the valence of the ions from which it is deposited on the cathode, or which it forms when the anode dissolves, then the equivalent weight e is equal to A/v. It follows, therefore, introducing the result of Faraday's laws, that the weight of metal deposited or dissolved is equal to

$$\frac{I \times t \times A}{v \times F}.$$

In order to make use of this expression there still

remains the constant F to be determined. This is most easily done by performing an actual experiment in which a known current in amps. (I) is passed for a definite time in seconds (t) through a solution of a metal, of atomic weight A, whose ions have a known valence (v); if the weight of metal deposited on the cathode is determined accurately it is clearly possible to calculate the constant F. According to the work of Faraday, which has been confirmed by many others, this is a universal constant and is not dependent on the nature of the metal being considered. In the most accurate work, carried out at the National Bureau of Standards, a careful study was made of the deposition of the metal silver from silver nitrate solution; the results showed that, within the limits of experimental error, the value of F, expressed in terms of coulombs, was 96,500. This constant is known as the *Faraday*, and it is always represented by the symbol F.

Inserting the value of F in the expression derived above for the weight of metal deposited at the cathode or dissolved from the anode, it is found that this weight W, in grams, is given by the equation

$$W = \frac{I \times t \times A}{v \times 96{,}500} \text{ grams.}$$

The significance of F may be seen from this equation by supposing that the quantity of electricity passed, that is, $I \times t$, is 96,500; the weight of metal deposited is then A/v, that is, the equivalent weight. It follows, therefore, that the passage of 96,500 coulombs, or one faraday, of electricity is always accompanied by a weight in grams, equal to the equivalent weight of the metal being deposited on the cathode or dissolved from the anode. If desired, the faraday may be expressed in amp.-hours, instead of in coulombs (amp.-secs.); the value is then 96,500 divided by 3,600 (the number of seconds in an hour), that is, 26.8 amp.-hrs. This quantity of electricity then results in the deposition of one equivalent weight, in grams.

Further consideration of the applications and limitations of the equation derived above will be given in the next article in this series.

IT'S GRAND RAPIDS *in* 1942

We invite you to try our hospitality by attending our

Fifth Annual

EDUCATIONAL SESSION and DINNER DANCE

Pantlind Hotel, Grand Rapids

SATURDAY, JANUARY 17, 1942

ROBERT WAGNER, Guide Lamp Co., *Presiding Officer*

◆◆

Educational Session

W. Pinner, Houdie-Hershey Corp.—Modern Electroplating of Acid Copper.

F. Savage, C. G. Conn, Ltd.—Useful applications of Bi-Polarity in Practical Plating.

Dr. Kessler, T. Presher Varnish Co.—Synthetic finishes.

◆◆

Dinner Dance

A fine dinner, the best of entertainment and favors for the ladies make this meeting the highlight of winter A. E. S. activities.

◆◆

GRAND RAPIDS BRANCH
of
AMERICAN ELECTROPLATERS' SOCIETY

NEW HAVEN BRANCH CLASS MEETINGS

On Tuesday, October 14, at the Sterling Chemistry Laboratory of Yale University, New Haven Branch held a class Organization Meeting for the 1941 and 1942 educational season. A formal letter had been previously sent out to individuals, manufacturers and other organizations announcing the educational program for the fall and winter season and requesting those interested to attend this organization meeting of the class. This year's educational program will consist of a course of lectures based on the general subject "Substitutions of Materials and Methods of Manufacture and Finishes Due to the Defense Program."

A program of prominent speakers has been made up each one of whom is well versed in some particular phase of industry which has been more or less affected by priority restrictions in materials and supplies for which substitutions have been found and adopted. The speakers engaged cover many branches of the industry who have been affected by these restrictions and their experiences with these substitutions should prove a great help to others who are still looking around for substitutes for their own particular lines.

President Joseph Sullivan and Vice-President Doc. Garner, who is in charge of the educational program, each gave a general outline of the purpose, possibilities and benefits of the proposed course. After a roll call of those present the class was duly organized with a membership of 65. The meetings for the class are scheduled for the second and fourth Tuesdays of each month from October to May, inclusive. The course is open to all A.E.S. members and any others outside the Society who care to join with us in this most interesting and vital subject.

The first lecture of the course was given on Tuesday, October 28. The speaker was Mr. Roy Lincoln, Polishing Engineer of the Carborundum Company, Niagara Falls, New York; his subject was "Substitution of Domestic Abrasives for Imported Emery Due to the Defense Program."

Mr. Lincoln in his talk first covered the source, the origin, the qualifications and the granular composition of the imported emerys. The cutting action of the many shaped crystals and their action and effects on the article to be polished were thoroughly described. The life of these crystals and the method of making up and setting up of the imported emery crystals for use in set up wheels and abrasive belts was outlined in full detail.

In contrast to the imported emery, the domestic type of abrasives were fully explained. The method of manufacture and the cross section and size of crystals was definitely outlined. A very thorough application of the use of domestic abrasives in many phases of industry were described. The method of making up many types of set-up wheels and belts was gone into in detailed form. Finally a classification of the many types of artificial abrasives was given and the general uses of each classification were explained.

The lecture was concluded by the answering of many questions from the floor covering individual and isolated cases of the use of domestic or artificial abrasives as a substitute for imported emery. A very interesting and elaborate sound moving picture compiled by the Carborundum Company covering the manufacture and many uses of artificial and domestic abrasives in all phases of industry was shown. This film is indeed a credit to its producers and should be viewed by any who are interested in the use of abrasives.

C. GARNER, *Vice-Pres. in Charge of Educational Program.*

AUGUST P. MUNNING

August P. Munning passed away on October 29 at the home of his daughter, in Matawan, N. J., after several months of illness. He was 68 years old.

A. P. Munning was one of the outstanding figures of the electroplating industry in America. Born in Chicago, March 8, 1873, he entered the electrical industry at an early age, going with the Leonard Izard Co., who were then agents for the original Edison Co., in 1888. At a later date he joined the Cutler Hammer Mfg. Co. of Milwaukee, rising with them to the post of General Sales Manager, with offices in New York.

In 1911 Mr. Munning entered the electroplating equipment and supply business, organizing the Munning Loeb Co. in Matawan, N. J. In 1918 this firm was merged with the George Zucker Co. of Newark with Mr. Munning as president of the new concern, A. P. Munning and Co. In 1927 the latter

A. P. MUNNING

company was merged with the Hanson and Van Winkle Company to form the Hanson-Van Winkle-Munning Co., with Mr. Munning as Chairman of the Board. He retained this post until his retirement in 1935. A few years later Mr. Munning again became active in the Hanson-Van Winkle-Munning Co. as a member of the Executive Committee. He again retired in 1940 to become President of the Matawan Bank, in which post he continued until his recent illness.

Mr. Munning was internationally known for his accomplishments in the electroplating industry. He was an Edison Pioneer. He was a strong sup-

porter of the American Electroplaters' Society and an ardent believer in raising the standards of the industry.

Mr. Munning pioneered the movement to promote the use of full automatic methods of cleaning, plating, and drying of practically all of the various products that are now so universally used throughout the industry. In 1918 he placed on the market for industrial uses the Broderick Full Automatic Conveyor that had been adopted for use in cleaning, plating and drying in the hardware industry. A few years later he developed the use of the Munning Full Automatic type conveyor, and these are in use in practically all of the metal plating industries throughout the country.

As an electrical engineer, he was early to see the advantages to be gained by developing better electrical and chemical equipment for our industry through laboratory control of solutions and processes. He also manufactured and introduced the High Purity Anode products that are now standardized throughout the electroplating industry.

Mr. Munning leaves his mother, Mrs. August A. Munning of Chicago; his widow, Mrs. Anna V. S. Munning; a daughter, Mrs. John A. Bauer; four brothers, Nicholas and Peter Munning of Matawan, and Joseph and Harry Munning of Chicago; and a sister, Mrs. Charles Thelen of Chicago.

SUPPLIES AND DEFENSE

by
W. D. Starr
The Lea Manufacturing Co., Waterbury, Conn.

A new OPM Order No. M-18-a supersedes General Preference Order M-18 to cover chromium including chemicals such as chromic acid. The new order limits the use of ore for chromium chemicals and specifies that the Director of Priorities may periodically allocate deliveries of chromium in any form for particular uses. For delivery of chromic acid during any one month firms are to apply not later than the 25th of the preceding month on Form PD-53-b or other forms which may be prescribed by OPM from time to time. Under the new order, chromium will join the list of items the distribution of which will be controlled by allocation in the near future.

Cobalt has been placed under direct allocation by OPM Order M-39. Deliveries of Cobalt chemical compounds for non-metallic uses are limited to 90% of the average monthly weight delivered during the first six months of 1941.

Under consideration is a plan to substitute cartridge shells made of soft steel and plated with copper for shells made of pure brass, and it is estimated that this would save about 400,000 tons of copper during 1942. There may be a number of items where a similar substitution can be made which will make for activity in copper plating.

In case the operations of any firm are seriously restricted by copper order M-9-c, an appeal may be written to OPM on Form PD-167. In considering appeals, dislocations of employment and freezing of inventories, useful only for the products previously manufactured, will carry weight.

Many electroplating supplies are being ordered with Rating A-10 under Preference Rating Order P-22 as amended. OPM particularly warns that anyone making use of this order should study it carefully to be certain they are qualified.

It is anticipated that we shall soon have a Production Requirements Plan under which requirements for Defense will be the basis for allocation rather than sales as in the case of the Defense Supplies Rating Plan. Form PD-25-a is planned for this purpose. It appears that this Plan will follow the general trend away from individual Certificates toward Allocation.

GRAND RAPIDS ANNUAL BANQUET AND EDUCATIONAL MEETING

The Grand Rapids Branch of the A.E.S. will hold it's fifth annual banquet and educational meeting, Saturday, January 17, 1942 at the Pantlind Hotel.

Platers and their friends who have attended the previous Grand Rapids banquets have memories of a grand time, good food, good entertainment and many useful ideas obtained from the better than average educational sessions. The banquet and the educational session this year will be no exception, in fact both will be better than ever.

The educational session this year promises to be very interesting because of the timeliness of the papers and because of the interesting and entertaining speakers who have agreed to give the papers. Walter Pinner of the Houdie-Hershey Corp. will give a paper on "Modern Electroplating of Acid Copper." Mr. Frank Savage of C. G. Conn Ltd. will talk on "Modern Electroplating and Intermediate Anodes." Mr. Savage's paper will be most interesting to those who have problems pertaining to difficult items to plate. It is also planned to have a speaker on "Synthetic Metal Finishes" which will be of vital interest to all who are changing their finishing over from plating to paints and enamels. The speaker on the latter subject will be announced at a later date.

The committee in charge of the arrangements for the banquet will for the most part be the same as has already been appointed for the 1942 National Convention. This committee will be under the direction of Chet Smith and he will be assisted by Homer G. Morton, Finances; L. B. Sperry, Educational Program; Stewart Z. Martin, Banquet and Entertainment; Charles O. Werft, Tickets; F. D. Pace, Publicity; and C. E. Abel, Secretary.

Grand Rapids Branch banquets have enjoyed a phenomonal growth from year to year which forces us to limit the sale of tickets this year. To make sure of securing tickets and reservations write Mr. C. O. Werft, 1107 Powers Ave., Grand Rapids, Michigan, promptly.

SPEAKERS AVAILABLE TO A.E.S. BRANCHES

These speakers are all sponsored by the Electroplating Division of the E. I. DuPont Company of Wilmington, Delaware.

Subject	Speakers
High Speed Copper Plating	C. J. Wernlund and H. L. Benner
Zinc Plating	R. O. Hull and C. J. Wernlund
Lead Plating	A. G. Gray and Wm. Blum
Tin Plating — Alkaline Solutions	F. F. Oplinger and F. Bauch
pH Control in Alkaline Solutions	A. G. Gray

FILMS AVAILABLE TO A.E.S BRANCHES

Sponsor	Subject	Remarks
E. I. Dupont Co. Wilmington, Del. Electroplating Div.	The Story of Nepprene	16 mm. film
Douglas D. Rothacker 729 Seventh Ave. New York, N. Y.	Nickel Highlights	40 mm. sound film presenting highlighted story of nickel.

ANNOUNCEMENT

I have just moved my Metal Finishing and Plating Laboratory to larger quarters at 233 W. 26th St. (Penthouse) from where I will continue to give the same expert analysis, trouble shooting, installation and consultation service to the Metal Finishing Trade. The same reasonable prices of course.

—Joseph B. Kushner.

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Here and There

SYRACUSE BRANCH

Having received several invitations from various members of the A.E.S. in New York State, we decided to spend a few days there. We visited George Simmons, the newly appointed secretary of Syracuse Branch, who resides in Herkimer. George persuaded us to stay over night, which we did, discussing A.E.S. problems in general and Syracuse branch in particular. We agreed that the prospects for a strong branch in Syracuse were exceptionally good.

In Syracuse we paid our respects to Dwight Overcash, Brown-Lipe-Chapin Corp., new president of the Syracuse Branch, who invited us to call when next we visited this territory. Mr. Overcash, with his assistant, Mr. Angelo Giorgi, branch librarian, are both working hard to provide top notch speakers to make the meetings interesting and also to increase the membership. Dr. M. M. Beckwith of the J. B. Ford Co., a close friend of Mr. Overcash addressed the October meeting while R. J. Sizelove of the Frederick Gumm Co. was the speaker for November. We expect several new applications soon from Syracuse Branch in the near future. How about it, George?

BUFFALO BRANCH

An account of the Buffalo Branch meeting is given by the secretary on another page. President Joe Ruff picked us up at the hotel and drove us to the meeting place. There was a fair attendance. After the picture presented by the Carborundum Company, the business meeting was held. A discussion regarding the 1943 convention lasting over an hour brought a lot of questions, the answers to which were more or less of a surprise to some of the members.

The Executive Secretary spoke very frankly about the work involved and the cooperation necessary on the part of the entertaining city to produce a successful convention.

Dr Wernlund of the duPont Company spoke about the possibility of another joint meeting between Toronto and Buffalo, similar to last year's meeting at Niagara Falls, Ont. It is good to see this feeling of International Fellowship between the branches. Our sincere thanks are extended to Mr. Bill Fotheringham, chairman of the membership committee of Buffalo Branch for his work in securing new members. Thanks are also extended to Roderick McGhee for sending in reports of the branch activities. The meeting wound up with a "fish fry" around midnight.

Thanks, boys, we had a swell time. Be assured of our deep interest in the International Meeting in Canada. We hope to visit Rochester and Binghamton branches before long.

PROVIDENCE BRANCH

Providence Branch meeting was held at the Biltmore Hotel, November 17, 1941. After luncheon in the Town Room the meeting was called to order about 8:30 P.M. by president R. D. MacLachlan. A most interesting talk was given by Mr. Warren, representing Divine Bros., Utica, N. Y., on "Polishing Wheels of Various Kinds." Mr. Warren not only discussed the subject mentioned, but dealt with glue, buffing wheels, the importance of control in the wheel room, the polishing wheels used for various metals, how to prepare wheels for abrasives, etc.

We hope Mr. Warren will be invited to give this address before many of our branches and that he will prepare a paper for publication in the REVIEW. There is a lot of information in the address that all our members should know about. The meeting was well attended. At the December meeting the subject in all probability will be "Rectifiers."

DOCTOR GLASSTONE'S ARTICLES APPRECIATED

The following letter in connection with the series of articles by Dr. Glasstone, now appearing in the REVIEW, has been received from the Missouri School of Mines and Metallurgy. "I think it would be a valuable contribu-

tion to art and science of the electroplating industry, and very useful to the men in it if the serial articles by Glasstone on the "Fundamentals of Electrochemistry and Electrodeposition" could be reprinted as a bulletin after he has completed his series. The information contained in these articles could hardly be found except by referring to many different books on the subject. Here it is in a concise form and described in a simple manner. I think such a bulletin, if advertised in The MONTHLY REVIEW, should have a substantial subscription at a price that would be popular. I shall appreciate it if some thought could be given this proposition."

Mr. Louis Gagnon, member of Boston Branch, writes: "We would appreciate receiving about ten copies of the REVIEW each month containing Dr. Glasstone's articles. The men in our chemistry class at M.I.T. will be glad to get them and I feel sure that several of them will want to join Boston Branch."

Mr. Albert Hirsch, speaking from his experience with students in Jules Mastbaum School, Philadelphia, writes to Dr. Glasstone as follows: We quote from a copy of Mr. Hirsch's letter sent to us. "It is my thought that your articles appearing in The MONTHLY REVIEW may be put in book form, as I think there is need of such a book. A book that would contain such electrochemistry as it applied to electroplating would be much more useful to the plater, than books which try to cover the whole field of electrochemistry."

PHILADELPHIA BRANCH ANNUAL MEETING

The annual meeting of Philadelphia Branch was held on Saturday, November first, at the Broadwood Hotel. Considering that it rained all day and that one of the biggest football events of the year was being played in the Quaker City, the attendance was good. Mr. Eugene Zurbach, chairman of the Educational Committee, presided and introduced Dr. William Blum of the National Bureau of Standards as the first speaker. His subject was "The Effect of Metal Shortages on Plating Materials." Dr. Blum's talk was listened to with the closest attention. Prolonged discussion was engaged in after the close of the address.

Dr. J. E. Stareck of United Chrome, Inc., Waterbury, Conn., who chose for his topic "Unichrome Alkaline Copper," was the next speaker. This was a most interesting address regarding a new process in which those present were quick to ask questions concerning the various details connected with the operating of the bath. Dr. Stareck showed many samples which helped to further increase the interest already aroused.

"Changes in Cleaning Methods Due to Defense Problems" by Robert Sizelove, Research Chemist, Frederick Gumm Chemical Company, proved to be another paper carefully prepared and contained a fund of information that will be of much value wherever it is read. Bob showed his familiarity with the subject by the capable manner in which he answered all questions asked of him by many members in the audience.

This was a good session comparing favorably with all previous educational sessions sponsored by Philadelphia branch, where the best speakers available are sought for their annual meetings.

The banquet at 7 P.M., at which 330 were present, was one of the best we have seen. The floor show was excellent, all acts bringing prolonged applause. Many beautiful gifts contributed by members and friends of Philadelphia Branch including supply houses were given to persons holding the lucky tickets. This part of the program caused plenty of excitement especially with the ladies. The committee consisting of George Gehling, Joe Underwood, A. G. Snow, J. D. Dimon, Del. Robson, and George Long are to be highly commended for their splendid efforts in bringing to such a successful conclusion another annual meeting of the Quaker City Branch.

Business and Social News

BRANCH NEWS

Educational Activities

AMERICAN ELECTROPLATERS' SOCIETY

Providence-Attleboro Branch held its October meeting at the Providence-Biltmore Hotel, Providence, R. I., on the usual third Monday of the month. Total attendance was 40. Our speaker this time was Dr. A. K. Graham who made this appearance under the sponsorship of McGean Chemical Company. His topic was "Problems Involved in Substituting Steel for Other Basis Metals in Electroplating."

Dr. Graham handled this topic in his usual clear and thorough manner. His definite pointers concerning the basic differences between characteristics of various steels was well developed. He brought out the troubles to be expected from surface conditions on steels, the fabricating effects, pickling differences to be looked for, variations in polishing procedure, cleaning steps, etc.

He treated nicely the matter of chosing deposits to be applied for various services and gave us good pointers on the limitations to be looked for in certain metals when deposited on steel. Also he spoke of recently considered deposits of combinations of metals. Questions indicated that there were many present who had to consider production of plated steel products and they were undoubtedly helped considerably.

There were three applications for membership received. We were especially pleased to have several visitors from the Boston Branch. These included the branch president, William Jones, the secretary, Andy Garrett, and the librarian, Louis Gagnon. The latter gave us an excellent outline of the chemistry course they are sponsoring at present. We are sure they are doing a real constructive job, in this way, in bringing along young men interested in electroplating.

Inter-branch visits are a great help to all—come over again, fellows.

FREDERICK E. ALLEN, *Secy.*

Boston Branch held its regular meeting on Thursday, November 6, at the Hotel Statler. This meeting was planned as a social evening to view the movies of the National Convention Outing and wind up the activities associated with the convention.

As in every Branch undertaking, a large share of the work of the past convention fell upon the shoulders of a few. In recognition of outstanding contributions toward the success of the convention Boston Branch presented gifts to Ann Baker, Joe Barron, and Andy Garrett. President William Jones made the presentations. Ann Baker, who worked tirelessly as convention hostess was given a beautiful jeweled gold pin. Joe Barron, national chairman, received a pen and pencil set, and Andy Garrett, Secretary-Treasurer, was given a pipe. The thanks and best wishes of all the members of the Branch go with these gifts.

The program featured three motion pictures. First a movie of the 1936 Boston annual Outing photographed in color by Bob Leather. This film showed many of the members of the Branch five years younger and proved highly entertaining. The next movie was a color and sound picture presented

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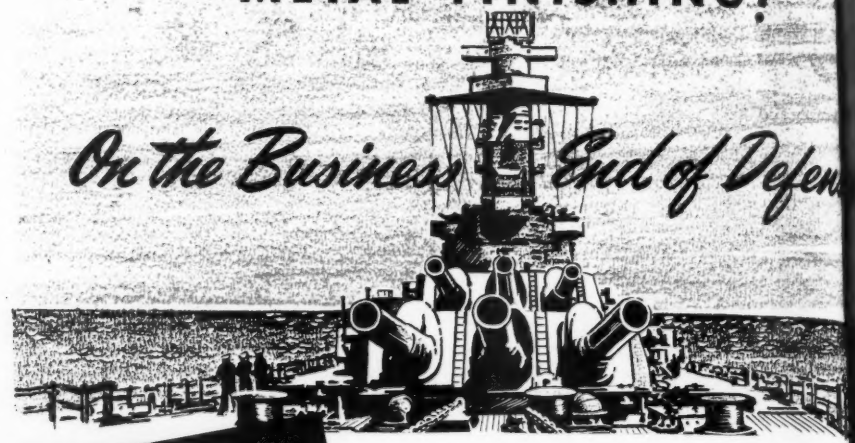

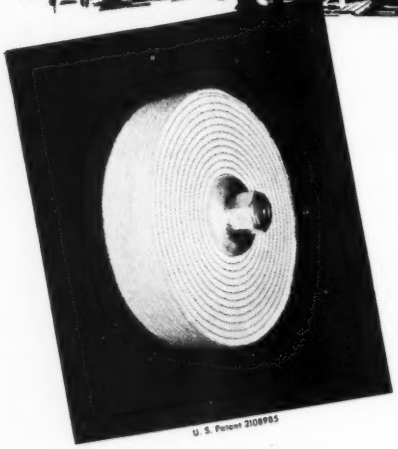

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by DuPont and entitled, "A New World Through Chemistry." This showed the development, manufacture, and use of nylon and rayon, fucite, and other DuPont products.

Finally the M. E. Baker Co. presented the color moving picture of the National Convention Outing at Pemberton Inn. This was a sound film photographed and voiced by Al Baker. The camera caught A.E.S. members from all parts of the country as they relaxed and enjoyed themselves at Pemberton; Al Baker singled out a large number of prominent and well-known men as he made the camera record of the grounds and activities. Everyone enjoyed seeing and living again the fun at the outing. Since so many were anxious to see this movie, we had a large attendance. Among the visitors we were happy to welcome were Dr. Dubois of Boston University and Ralph McCahan of DuPont.

Following the movies, refreshments were brought in and an hour of visiting, and sociability brought this pleasant evening to a close.

A. W. GARRETT, *Secy.*

Toledo Branch held its regular monthly meeting in room 224 of the Macomber High School on Thursday of October second with all of the officers and 18 members present. The meeting was opened by President Vannorsdall at 8:00 o'clock P. M. A letter to the Dayton Branch in reply to a request for Toledo's cooperation in the promotion of a joint meeting was approved.

A suggestion by Mr. Vannorsdall to have large posters printed and sent to all the plants in the vicinity who use electroplating, advertising the educational programs of our meetings was approved. The secretary was instructed to inform the Dayton and Cleveland branches as to the net receipts of the joint meeting held last May. A 15 minute picture on nickel refining was shown, through the courtesy of the Bureau of Mines, Dept. of Interior, in cooperation with the International Nickel Co. Lt. O. R. Omhoff, of the Ordnance Dept. of the U.S. Army, was the principal speaker of the evening. Lt. Omhoff talked on specifications of equipment for the Ordnance Dept. The talk was very interesting and educational especially for those members who are working, or are to work, on defense material. The members expressed their appreciation by a rising vote of thanks. The meeting adjourned at 10:00 o'clock P. M. Lt. Omhoff spent about an hour after the meeting was over, chatting with the boys and answering questions that were being asked him by interested members.

GASTON BERGEMAN, *Secy.*

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Newark Branch held its regular meeting on Friday evening, October 17, at the Hotel Robert Treat, Newark, N. J. The meeting was called to order at 8:30 P.M. with President William T. Maguire presiding. Mr. Horace Smith stated that a very good program was being arranged for our Annual Christmas Party and that ten captains had been appointed to handle chance books which were ready for distribution among the members. Mr. Paul Oldam asked for volunteers to act in a show which he was coaching for this party.

The Educational part of this meeting consisted of an "Information Please" program to which three experts were appointed to answer questions. The experts were Dr. Walter R. Meyer, editor of Metal Finishing, Mr. Gustave Klinkenstein of Maas and Waldstein, and Mr. Adolph Bregmann, Consultant. Although some of the questions were previously arranged by our membership, these men had no idea just what questions would be asked. Our Librarian, Mr. Louis Donroe, anticipated that this would be a very interesting meeting so he engaged a stenographer who recorded the questions, answers and discussions. (This is published elsewhere in the REVIEW. —Ed.)

The experts were given a rising vote of thanks by the 64 members who attended this meeting which was most interesting and educational. Meeting adjourned at 11 P. M.

GEORGE WAGNER, *Secy.*

Cincinnati Branch held its regular monthly meeting, Friday, October 23, at 8:00 P.M. The question of the Cincinnati Branch joining with the technical and scientific societies of Cincinnati was presented to the membership. The Librarian stated that the purpose of this organization is to coordinate the various technical societies so as to prevent the conflicting of meeting dates and give them the proper publicity. To join the local council the society must be a member of a National Society and be considered on the right plane and desirable. Several of the members of the branch will meet with the officers of the local council and if the Cincinnati Branch meets the above qualifications they will be invited to join with them.

The remainder of the evening was given over to Mr. Chester Smith of Grand Rapids, Michigan, whose subject was "Nickel Plating with Insoluble Anodes." Mr. Smith recommended plating with insoluble anodes not as a practice but only as a stop gap because where they are available nickel anodes give better results and the solutions are cheaper to operate. Mr.

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Smith advised that the solution be operated at a slightly lower temperature than the Watts solution keeping the pH between 1.5 and 3.0. Methods of replenishing the solution, kinds of anodes which can be used and solution contamination were also discussed.

To stimulate the question and answer period at recent meetings the following method has been adopted. Each person attending was asked to donate 25 cents and was given a numbered card on which to write his name and a question pertaining to the subject chosen for the evening. After the speaker had completed his talk, the cards are collected and the questions read aloud and answered by the speaker. The cards are then put into a hat and the winner drawn. One half of the money collected is given to the winner and the other half is turned into a fund which is to be used to help defray the expenses of a delegate to the next A.E.S. Convention.

The meeting adjourned at 10:30 P.M.

MARTIN M. GANNON, JR., *Secy.*

Philadelphia Branch held its October meeting at the Harrison Lab., University of Pennsylvania, 34th and Spruce Sts. Our guest speaker for the evening was Mr. C. Lankau of the Egyptian Lacquer Company. The topic presented was "Protective Coatings for Electroplaters." Mr. Lankau gave us a very thorough talk on the manufacture of lacquer and its properties.

There were 40 members present at this meeting.

PAUL MENTZER, *Secy.*

Binghamton Branch held its regular monthly meeting on Friday evening, October 31, at the Hotel Cortland, Cortland, N. Y. The meeting was called to order by our President, Mr. William Mahar. The application of Mr. Duane Lawton was acted upon and accepted as associate member. Also F. W. Kenyon was made an active member instead of associate. There being no further business the meeting was turned over to our Librarian Mr. Harry Herlikofer.

Mr. Herlikofer introduced as guest speaker Mr. Anthony Chenis of the Bullard Dunn Co., Bridgeport, Conn. Mr. Chenis explained the Bullard Dunn process which is an electro-chemical method of removing scale and oxides from the surface metals, particularly the ferrous metals. The characteristic feature is that a continuous and non porous metal film, usually tin, electrodeposited on the work simultaneously with the scale and oxide removal, protects the work from pitting and etching.

In behalf of the Branch I wish to thank Mr. Chenis for the fine talk, and

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also the Bullard Dunn Co. for making this possible.

F. W. KENYON, *Secy.*

Montreal Branch held its regular meeting at the Mount Royal Hotel on Monday, November 3. The meeting was called to order at 8:15 P.M. with President Jordan presiding. The Branch had a record attendance, thanks to the worthy efforts of our Librarian Mr. E. H. Marsh of the Union Screen Plate Co., Lennoxville, who has worked very hard to make our meetings most interesting and instructive.

Mr. Lloyd of Johnson Matthey Co. who is Hon. Secretary of the Society of Chemical Industry, Montreal Section, invited the members to attend a meeting of the Society on November 19, the subject being "High Strength Resins" given by Mr. T. S. Carswell.

The business session being completed, the meeting was turned over to our Librarian who spoke on the "Contamination of Solutions" taking into consideration the effects of the carelessness of the plater in rinsing and handling of different pieces. The effects of certain impurities in solutions and how to overcome most of them by using bagged anodes, filtering, and using low C.D. for removing metallic impurities. He also answered many questions asked by interested members.

EUGENE FEELEY, *Secy.*

Toronto Branch held its regular meeting on November 7, at the King Edward Hotel. President Graham in the chair welcomed John Young and Billie Wells and noticing the absence of Tom O'Keefe, Alex Armstrong and Harry Bird. A letter was read from Rod McGhee and Dr. Wernlund. John Acheson spoke about meeting some of the Buffalo members at Niagara Falls to make arrangements for joint meeting

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sometime in April, 1942, also an invitation to Buffalo members to visit Toronto the first Friday in December.

Six applications were balloted on and the following became members of Toronto Branch: Edward Scobie, George Childs, James Vaughan, Stewart McLoud, George Gresswell, and Herbert Brock.

The speaker of the evening was Mr. Walter Barrows who spoke on the history of Toronto Branch, stating the branch received its charter April 26, 1912, Walter being the first president. A few members were still active in the branch and for 29 years had worked together in the interest of the A.E.S. Walter outlined the joys of brotherhood, and mentioned little sad events regarding the few who are not with us now.

Starting from 1912 and continuing up to 1941 Walter had a lot to say and showed delegates badges and photos aplenty. A truly historical review of Toronto Branch was given. The members gave Mr. Barrows a great ovation, and as one member remarked Walter is a great GUY.

JAMES S. CAIRNS

Detroit Branch held its regular monthly meeting Friday, November 7, at 8:15 P.M., at the Hotel Statler with Vice-Pres. Fritts presiding.

A fine attendance of about 200 persons enjoyed the educational program provided by the Aluminum Company of America. A large display of aluminum products was on exhibition showing the various finishes that are obtainable. Mr. Pettit and Mr. Roberts, the guest speakers covered the subject of aluminum finishes in its entirety. A great many still pictures were shown during the talks. A moving picture was shown later. This dealt with the manufacture of aluminum and covered all stages of processing from the mine to the manufacture of finished products.

After an open discussion of the subject, the Question Box was handled by Mr. Hahn and the meeting adjourned at 11:00 P. M.

WARREN I. GRIMMER, *Secy.*

Chicago Branch held its regular monthly meeting on November 8 at the Atlantic Hotel, President C. Kelly presiding. The following applications were read and committees appointed on same: Mr. P. Moore, E. A. Keyser, L. Bell, and H. R. Bielenberg.

President C. Kelly appointed Mr. L. Borchert and Mr. E. H. Lyons, Jr., to work with Mr. E. Woodmansee in securing speakers for our branch meetings. They promise us some very interesting educational features, and all members are urged to attend these meetings. A motion was made by

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Mr. C. Kocour that a vote be taken by the entire Chicago branch membership to see if they would like to meet on any other week night than the present one. Members were urged to mark their ballot cards and return them promptly. Mr. O. E. Servis attended the meeting, his health quite a lot improved; he looks fine and we all hope he will soon be fully recovered.

Mr. Gilbertson, the chairman of the Banquet committee, stated that all plans were complete for our 30th Annual Educational Session and Banquet to be held Saturday, January 31, 1942, at the Palmer House. This will be the finest Educational session and Banquet ever held by Chicago Branch, so be sure to remember the date.

Mr. E. H. Lyons, Jr., introduced the guest speaker of the evening, Mr. W. L. Pinner, president of Detroit Branch, who made a very fine interesting talk on "Materials Savings." After quite a lot of discussion, Mr. Pinner answered many questions and was given a rising vote of thanks. We hope he will visit us again soon. J. W. HANLON, *Secy.*

Buffalo Branch held its regular monthly meeting at the Bailey Bowling Academy Friday, November 14. We were honored by a visit from our Supreme Secretary, Mr. W. J. R. Kennedy, who in response to our request had a few words to say regarding the future of the industry in general. Commenting further he drew a cold-blooded unvarnished picture of the work and co-operative effort necessary to successfully promote a convention. The matter was left open and will undoubtedly be the subject of much discussion at our next meeting.

Our guest speaker, Mr. J. C. Mays was introduced by Dr. Wernlund. As his subject he had, "The Application of Abrasives in Modern Industry." With an excellent sound motion picture, it was shown how modern industry depends to an almost unbelievable extent on the use of abrasives. The film covered the complete range of the subject from their discovery to their application in highly specialized equipment. Precision grinding of camshafts with a plus zero tolerance and screw cutting of a very fine thread by a grinding wheel were among the incredible wonders shown as a development to meet the needs of industry. It is a film well worth seeing over again and should be much in demand throughout the branches. Mr. Mays added further to its interest by answering the questions which such a subject so ably presented will evoke.

RODERICK MCGHEE, *Secy.*

New Haven Branch held an open meeting on Tuesday evening, October

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7. Mr. Jack Harper of the Jackson Buff Company, Long Island City, gave a very interesting talk to the members and guests of New Haven Branch. The subject was "Recent Advances in Automatic Buffing." The movements in hand buffing; namely, (1)—Pick up Work, (2)—Apply Abrasive, (3)—Hold Work Against Wheel and (4)—Lay Down Work, were compared with the simpler cycles of semi and full automatic buffing. A comparison of the number of wheels with which the work makes contact in the three classes of buffing was indulged in, namely the hand method, one half a wheel, the semi-automatic, two wheels and the full automatic a battery of wheels.

The outstanding advantages of full automatic over semi-automatic were listed as follows.

1. One chucking operation for a succession of wheel angles or a succession of different operations.
2. Work comes to operator instead of vice-versa.
3. More buffing angles than practical even in a series of semi-automatic operations.
4. Compounds applied to wheels.

It was brought out that the ratio of hand buffing to average full automatic buffing was estimated as one half wheel for hand work and three and one half wheels for full automatics or seven times the amount of hand buffing.

The newer types of full automatic buffing machines were listed as Rotary or Indexing type, straight line type and continuous rotary type. An example of the production of a straight line machine was given in the buffing of hard rubber combs. The maximum hand production was 500 combs per hour while the straight line automatic machine on the same operation produced 10,000 combs per hour.

A moving picture film showing several types of full automatic machines in the setting up and operating cycles was run off to amplify some of the points brought out in the talk. Many questions from the floor were answered by the speaker particularly in reference to proper speeds for various articles to be buffed. The concensus of opinion in regard to speeds seemed to be toward the slower speeds to allow the wheel to mesh rather than the higher speeds formerly recommended.

On Tuesday evening, November 4, at the Sterling Chemistry Laboratory of Yale University, an open meeting was

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held. At this time, Mr. Oscar Stocker, Chief Chemist of the Seymour Manufacturing Company of Seymour, Conn. gave a very interesting talk. The subject of the talk was, "Chemical and Electro Chemical Purification of Plating Solutions."

Mr. Stocker's talk covered nearly all classes of plating baths and the elements both mineral and organic with which they may become contaminated. Methods were explained whereby each one of these contaminating elements could be removed. The methods described included elimination by additions of different chemicals, by the dummy plating out method and by filtration with activated carbon.

Questions from the floor were answered by Mr. Stocker after which a rising vote of thanks was given to him for his fine paper.

CLARENCE GARNER

Pittsburgh Branch held its regular meeting on Thursday, November 6, at the University Club with 38 members and friends present. This was an exceptionally good turnout considering the very bad weather.

Our speaker of the evening was Dr. A. Kenneth Graham of Jenkintown, Pa., who talked about "Problems of Applying Electroplating to Strip." Dr. Graham presented the general principles of plating particularly those involved in the plating of strip, and the economics of such practice.

1. Labor cost is low.
2. Power costs depend on current, which is proportional to the weight plated, and on voltage, which depends on (a) IR drop of solution, (b) IR drop of contact, and (c) polarization voltage of anode and cathode.
3. Maintainance cost is higher for high speed plating than job plating.

The following is generally true regarding the solution.

1. Anode-cathode relationship is important for equal distribution.
2. The solution is tailor-made for the job.
3. Agitation is very important.
4. If addition agents are used, stability of these agents is important.
5. The bath should be cleaner than ordinary baths.
6. The problem of preventing (reducing) dragout at high speeds is very important.
7. Problem of controlling chemicals or additions to bath is greater at high production speeds.
8. Roughness is important from (a) anodes, (b) atmosphere, and (c) solution.

Dr. Graham's talk was well received as evidenced by the discussion which followed.

FRANK KELLER, *Secy.*

Newark Branch held its regular meeting on Friday evening, November 7, at the Hotel Robert Treat, Newark, N. J. The meeting was called to order at 8:30 with President W. T. Maguire presiding. Communications from Chi-

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cago Branch and City of Asbury Park were read and placed on file.

Applications for Michael D'Elia and Adam Munn to Active Membership; for Henry W. Lovett, Oliver Gautreau, John Cluff, and James Phelps to Associate Membership were voted to take the regular course. Mr. Raymond A. Ward and Mr. Peter Catania were elected to Associate Membership.

Mr. Horace Smith reported on the Candee-Crane Dinner and the Philadelphia Banquet and the coming Christmas Party. He further stated that he had called a committee meeting for the coming week for the purpose of concluding arrangements and determining the admission charge to non-members.

This was the first meeting to which three of our own members were selected as speakers and were presented by Librarian Louis Donroe. Our first speaker was our own President, Wm. T. Maguire whose subject was "Evaluation of Organic Coatings." Mr. Maguire's paper was accompanied by slides on which he showed a variety of tests to which organic coatings were subjected. The next paper was by William Hodecker, Jr., on "Cadmium Plating for Aircrafts," and the third paper was by Zachary Irenas on "Tin Plating." All papers were very interesting and will be forwarded to Mr. Kennedy for publication in the MONTHLY REVIEW.

The meeting was attended by 54 members and some visitors, all of whom gave their full attention to the speakers.

GEORGE WAGNER, *Secy.*

Anderson Branch held its monthly dinner meeting November 11 at 6:45 P.M. at the Anderson Y.M.C.A. President R. W. Oyler presided. Librarian R. M. Wagner introduced the speaker for the evening, Mr. Frank Savage, Research Chemical Engineer for C. G. Conn, Ltd., Elkhart, Ind. Mr. Savage was assisted by Mr. Pfefferle in the presentation of a motion picture and talk on silver plating. The speaker explained the research problems which were necessary to automatic conveyorize silver plating of band instruments, and the picture showed the conveyor in operation as developed by months of research.

This presentation was particularly interesting because silver has been untouched by priority restrictions, and the numerous questions that followed showed a very high interest by everyone present.

E. L. MCKINNEY, *Secy.*

Cleveland Branch held its regular meeting on November first at Hotel Cleveland. The meeting was called to order at 8:30 P.M. by President P. R. Lyons with an attendance of 47. The weather was mild with some rain.

Under applications for membership the following were submitted: Mr. Frank DeMarinis, employed at The S. K. Wellman Co., residence, 2170 Stillman Rd., Cleveland Heights, Ohio; Mr. Lewis T. Briggs, Jr., employed at Erie Plating Co., residence, 710 Raspberry St., Erie, Pa.

Mr. Lyons reports that the Cleve-

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land, Toledo, Dayton Regional meeting was postponed for the present. A letter was read from the Toledo Branch stating that they request we accept ten dollars and thirty-six cents as our share of the profits from the last regional meeting. Motion was made by Mr. Honnecker and seconded by Mr. Friedl that we accept. Motion carried. It was then discussed that upon acceptance we can then decide what we will do with the money and would abide by what the other two branches decide.

Mr. Geo. Svenson was appointed as second vice-president as per letter from Messrs. Caldwell and Kennedy.

Mr. John Honnecker our librarian introduced the speaker of the evening, Mr. Paul Strausser, formerly with the Bureau of Standards, and now Consultant and representative of the F. B. Stevens, Inc., Detroit, Michigan.

Here are some of the features of his talk. Many of the platers feel that due to the fact that decorative plating of automobile hardware will be discontinued after Jan. first, that little plating will be done after this order takes effect. Contrary to this belief, Mr. Strausser feels that there will be more plating done, from a weight standpoint, for the Defense program.

Problems now confronting the plater in plating material for the Defense program will entrench him with knowledge which will be valuable to him in the future, especially in the finishing of automobile parts. Emphasis was laid on the need for the cooperation of everyone engaged in the plating field as the problems now presented to the plater are not by any means a one-man job.

Many of the common metals such as copper, zinc, cadmium, lead, etc., are now being plated on an extensive scale for the Defense program. While these common metals, such as lead and cadmium, have been plated heretofore for automobile parts, extreme care is being exercised in plating these common metals on parts such as airplane connecting rods and parts that are subjected to corrosive atmosphere. Metallic finishes which have been used by the automobile trade heretofore, would not, in many cases, be accepted by the Army and Navy inspectors; therefore one can readily see the reason why the plater of today must use his ingenuity in processing such metals.

The second part of the talk dealt with the methods involved in the testing of the electrodeposits cited above. The conventional methods of test were reviewed, such as salt spray, stripping method, dropping test, immersion test, jet test, Preese test, microscopic method and others.

All of these methods were compared

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with the Magne-Gage instrument for checking the thickness of electrodeposits. Some of the advantages stressed with the use of this instrument follow. Measurements are made in a fraction of the time required by conventional methods. The time saved gives staff time for other jobs. Eliminates costly rejection since it readily reveals whether or not the thickness of plating conforms to specifications. Every piece tested is unharmed and ready for use or shipment. Eliminates time wasting, tedious test procedure. No upkeep expense involved in its use, no auxiliary equipment and materials such as batteries, acids, tools, etc.

Its use readily suggests whether or not a redesign or rearrangement of plant equipment is necessary to produce a more nearly uniform distribution of coatings. It lends itself, therefore, to increased production and a better product. The Magne-Gage soon pays for itself (oft times in a few weeks) depending upon the number of measurements made, and will continue to be a profitable instrument long after its initial cost will have been absorbed.
Also every one of these instruments is calibrated by the Bureau of Standards at Washington and therefore is accepted as standard.

The Magne-Gage instrument is being used now extensively by the aircraft industry in measuring coatings of non-magnetic and magnetic coatings. One can readily conceive the importance of the Magne-Gage when applied to some of the expensive and highly finished aircraft parts.

A rising vote of thanks was given to Mr. Strausser for his talk and after a question and answer period the meeting was adjourned.

FRANK J. OPATRNY, *Secy.*

Los Angeles Branch held its regular meeting on November 12. After the usual routine business of the Branch had been disposed of, President Bedwell initiated discussion of the type of programs that would have the greatest interest to the members of the Branch. During the following discussion it was brought out that an educational program, the type of program which would have the greatest appeal to all of the members, should not be too advanced for those members who are just becoming platers. It should not be too elementary for those who are thoroughly experienced. The program must not be too technical for the members who are not chemists. The program and subjects discussed should be adequately supported by definite data. And of prime importance, all subjects on the program should be of interest to platers.

Mr. E. R. Holman, our Librarian, with his usual acumen declared that the problem was elementary and that he had a solution. He requested various members of the Branch to line up talks on those subjects and problems which they had encountered in their regular work. He offered the services of himself and second Vice-President Jim ApRoberts in the event that any assistance might be required.

The problem of programs for Branch Meetings having been so neatly solved President Bedwell appointed Mr. M. D. Rynkofs Chairman of our Annual Educational Session and Dinner Dance to be held in 1942. The credit for our last affair goes to Mr. Rynkof as he was chairman of that also.

The meeting was then turned over to the Librarian who introduced Mr. ApRoberts who spoke on "Magnesium Processing, a Defense Suggestion." While this was a subject that we have had, as yet, very little experience with it is without doubt a coming problem.

Mr. ApRoberts explained that the process is similar to those with which the plater is familiar.

We then went into the Question Box period which brought up a subject for a talk for the next meeting, "Removal of Iron from Cyanide Copper Solutions," to be given by Mr. D. Eldered of the DuPont Co.

ERVIN FRAUENHOFF, *Secy.*

Rochester Branch held its regular monthly meeting Friday November 14 in conjunction with a Dinner at the Rochester Turn Verein. There were 53 members and friends in attendance. After an excellent dinner the meeting was called to order by President John Adams. The following applications were then read and ordered published: Mr. Wm. J. Donovan, active, Mr. Emerson G. Doell, associate, Mr. Harry Weaver, associate, and Mr. Robert Berggren, associate.

The meeting was then turned over to Educational Chairman, Mr. Philip LoPresti, who introduced our guest speaker of the evening, Mr. J. O. Small, Vice-President of the Arco Co. Mr. Small gave a talk on the "Evaluation of Organic Finishes" a subject of great interest to everyone present. He told of the various tests for evaluating finishes such as the Salt Spray, the Impact and various other tests. He also told of the difficulties facing the industries today in having to change over to other types of organic finishes because of the shortage of materials to make the more modern types. After the talk he was beseiged by numerous questions all of which he very generously answered. He was then given a rising vote of thanks for a very interesting talk. The meeting was then adjourned. JUDSON R. ELSTER, *Secy.*

Grand Rapids Branch held its regular meeting Thursday, November 13 in the Rowe Hotel, President Morris Caldwell presiding. The meeting for this month was held one day earlier due to the deer hunting season, instead of on Friday. All officers were present and attendance of members and visitors approximating 70.

Minutes and communications were read and approved. Reports of committees were given, Mr. Caldwell giving a review of the progress being made on the January Banquet stating that the committee who are working on arrangements had nearly completed their work, and the sales of tickets is now being made. Members all were given a number of tickets as per roll call and arrangements made for mailing tickets to be sold to members who were not present.

Two new members were elected: Arthur L. Phillips and Charles Burrett Munton. Two applications were presented to be elected. A discussion took place as to starting a membership drive for new members at this time and Mr. Chester W. Smith was appointed as Chairman of the Membership Committee and he is to appoint his assistants and a drive for new members is to be started.

The speaker, Mr. J. J. Siefen was introduced by Mr. Stewart Martin. Mr. Siefen gave us an interesting talk on Polishing which proved interesting and instructive.

We had the usual Question Box and those members who did not elect to turn in their question, under new ararangements were asked to pay 10 cents for the lack of their question. Questions were read by Mr. Sperry and answers given by Round Table discussion of three members appointed by our President.

C. E. ABEL, *Secy.*

Baltimore-Washington Branch held its regular monthly meeting November 15 in Baltimore. Thirty-five members turned out for a fine steak dinner at Nolan's Cafe on Monroe St., served before the business session. Many of our regulars could not attend because of night and overtime work. Nevertheless we had a very good meeting, and a very fine educational session.

The rivalry of San Francisco and Hartford inspired our membership committee to respond to the challenge with the election of seven new members and applications from six more prospects. The Branch adopted a suggestion of Vice-President Caldwell's and voted that a book on plating be awarded the member securing the most new memberships during the year. It was also decided to hold a team contest for a dinner between Baltimore members led by Ken Huston and Washington members led by Sam Warnock.

W. P. Barrows was appointed chairman of arrangements for the annual meeting and banquet to be held in Washington on February 7th. A Defense program is being planned with speakers from the War Dept., the Navy Dept., and the OPM.

Mr. Charles A. Laukau of the Egyptian Lacquer Manufacturing Co. featured the educational session with a very nice talk on "Metal Lacquers" during which he used a display of samples quite effectively. His handling of a running fire of questions was especially commendable.

C. T. THOMAS, *Secy.*

Hartford Branch held its November meeting at the Hartford Electric Light Co. 294 Pearl St., Hartford, Conn., November 17. About 40 members and guests were present. Mr. R. H. McCahan of the duPont Company was the speaker of the evening. He spoke on "Tin Plating," and also showed duPont's movie "A New World Through Chemistry." This splendid movie barely scratched the surface in showing a few of the remarkable new products and processes that modern Chemistry and Research has given us.

The speaker advised the group that in his opinion tin offers the best possibility, at the present time, of all the corrosion resistant metals. Tin is used to a great extent in the food industry, milk apparatus, electro tin lining of tanks, refrigerator cooling units, typewriter parts and numerous applications where cadmium has been used in the past. The solution is only slightly corrosive, an excellent cleaner and has exceptional throwing power. As yet no process is available for bright plating is not practical over die-castings and chromium cannot be plated satisfactorily over tin. A dip in hot crisco, at approximate temperature of melted tin, will run the tin enough to give a smooth bright coat similar to the hot dipped tin. An anode to cathode ratio of about 1 to 1 is necessary to obtain the greenish yellow film on the anodes which denotes tin going into solution as stannic tin which is quite necessary. Otherwise stannous tin is formed and the deposit is rough and loose. Dilute hydrochloric acid and 2 ounces per gallon of antimony trioxide are used for a strip solution. It is unnecessary to say Mr. MacCahan's talk was highly appreciated.

Four members were elected at this meeting. James F. Burns, Philip Nigro, Clarence Rosenbeck, and Leonard Ravich. An application was received from Philip Atwood of the Eagle Lock Co., Terryville, Conn.

APLEY N. AUSTIN, *Secy.*

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Waterbury Branch held its regular monthly meeting in the Colonial Room of the Hotel Elton, Friday November 14. In the absence of the secretary, Bill Starr was kind enough to record the minutes which follow.

"The meeting was preceded as usual with a dinner at 7:00 P.M. President Ralph Colter called the meeting to order at 8:00 P.M. and announced the election of Stuart E. Judd as associate member, Mr. Ellsworth Candee, President of the Supreme Society and Mr. Richard P. Crane, President of the International Fellowship Club each spoke briefly in gracious acknowledgement of the Testimonial Dinner given recently under the sponsorship of the Waterbury Branch. Apparently the golf bag given Dick Crane and the shrubbery given to Ellsworth Candee, for his new home, hit the right spots.

"Mr. Wesley L. Cassell was Technical Chairman and he introduced the principal speaker Dr. Gustav Soderberg of Udylite Company who spoke on "Slants on Some of Todays Finishing Problems." Included on Mr. Soderberg's discussion were—

No. 1—Copper stripping methods.

No. 2—The possible substitution of

No. 3—potassium cyanide for sodium cyanide in view of the shortage of the latter.

The effect on plating quality of the depth of decarbonizing of steel in the case of high carbon steel.

No. 4—Laboratory analysis method for the non-pitting properties of a solution.

"A lively question and answer period followed Dr. Soderberg's talk.

"In place of the usual book review, Dr. Dubpernell discussed United States Patents, touching briefly on their practical value and upon the way they operate. This was followed by a review of patents issued in 1941 of particular interest to the plating and metal finishing industry.

"Dr. Charles Edlin discussed briefly a new use for the familiar acid copper bath. Copper salts have a marked toxic effect on many varieties of fungi, but copper sulphate applied as a solution has no effect on the fungus causing athlete's foot. However, by placing the feet of the patient in a copper sulphate bath and the hands in a salt solution and passing a current of the order of a few miliamperes at a potential of 40 to 50 volts through the solutions and hence through the body of the patient a cure of this disease is usually effected after several treatments."

SPENCER L. HENN, *Secy.*

Indianapolis Branch held its regular monthly meeting on November 5. The meeting was called to order at 8:00 P.M. by the President and the members present—numbering about 35—introduced themselves. President Fisher then announced that the speaker for the December third meeting is to be our National Executive Secretary, Mr. W. J. R. Kennedy.

As a vote of approval of the tentative decision of the Executive Committee to hold alternate discussion meetings and meetings with full-time guest speakers, it was moved and carried that this practice be continued. It was further moved and carried that on the discussion-meeting nights, each member be required to deposit either one question or $0.25 in the question box, the money so collected to go to the treasury.

President Fisher then introduced the speaker of the evening, Mr. Chester W. Smith of the J. C. Miller Company of Grand Rapids, Michigan. In his capacity as Convention Chairman of

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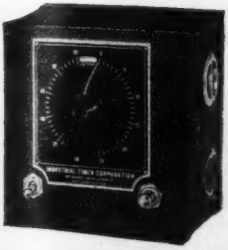

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the 1942 National A.E.S. convention to be held in Grand Rapids, Mr. Smith invited all members of the Indianapolis branch to be present and said that a sound balance between entertainment and educational benefits was being worked out.

Mr. Smith spoke on the subject, "Citrate Additions to Cyanide Copper Plating Solutions." Since Rochelle salts are becoming scarce and expensive, it is logical to substitute some material such as sodium citrate, which is a domestic product and which is even now less than half the price of Rochelle salts. Mr. Smith's research work on this subject enabled him to develop the following solution:

Copper (as copper cyanide)	2.0	oz./gal.
Free sodium cyanide	0.75	"
Sodium citrate	6.0	"
Sodium carbonate	2.0	"

pH 12.6 colorimetric—adjusted with potassium hydroxide.
temperature—150 degrees F.
Current density—50 amperes per sq. ft.
Anode area equal to cathode area
Anode efficiency—51.2%
Cathode efficiency—45.3%

When operated under the conditions specified, this solution produced deposits equal in every characteristic to deposits from the Rochelle copper bath operated under the same conditions. Mr. Smith specifically mentioned the fact that this solution, or any cyanide copper solution, should only be considered as a strike solution or for deposits under .0003 in., since the new high-speed copper and bright copper solutions are so far superior for heavy deposits. He stated further that the analysis for citrate was much simpler than that for the Rochelle salts.

After some discussion the meeting adjourned at 9:30 P.M.

E. A. BLOUNT, *Secy. Protem.*

Syracuse Branch held its November meeting at the University, Friday, November 21. This meeting had been postponed from the second to the third Friday on account of the Syracuse-Colgate football game. After a short business session during which the President, Mr. Overcash, outlined some very ambitious future meetings, the librarian, Mr. Giorgi, introduced in a very breezy introduction the speaker of the evening Mr. R. Sizelove of the Gumm Chemical Co. who had for his topic "Changes in Cleaning and Plating Technique Necessitated By Defense Demands And Civilian Metal Shortages."

The speaker reviewed the important role Parkerizing, Bonderizing, Anodizing, etc., are playing in the Defense picture. Any analysis of his talk merely emphasizes the rapid changes taking place in the metal finishing industry. The substitutes of today become the priorities of tomorrow. The Branch thanks the Gumm Chemical Co. for their cooperation in sending us their very able chemist to "tell us all the answers."

We have secured for our January meeting Mr. W. Schneider of the duPont Co. who will give us a talk on Tin Deposition. It is hoped that by then tin will still be available. The meeting will be held on January 9th.

We also trust that our Vice-President, Mr. R. Warner, will be quite recovered and able to attend to his duties at this meeting.

GEORGE SIMMONS, *Secy.*

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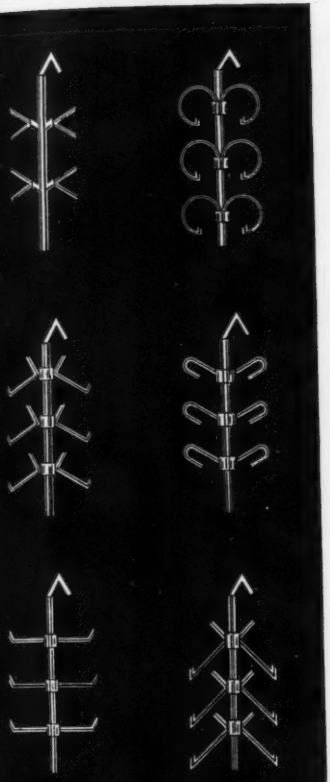

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THE QUESTION BOX

Los Angeles Branch

1. *How can iron be removed from a cyanide copper solution?*

Ans. No one present could give a definite answer to this question but Mr. Delos Eldered of the DuPont Co. offered to give a talk on this subject at the next meeting.

2. *What is a good formula for an acid copper solution?*

Ans. 27 oz. per gal. Copper Sulphate, 6.5 oz. per gal. Sulphuric Acid, Temp. 75° to 120°F., Current 15 to 40 amps./sq. ft.

3. *What causes cyanide copper solution to streak through to the base metal? —How can hypo be removed from the solution?*

Ans. Streaking is caused by too much cyanide and too little metal. Hypo can be removed by oxidation with hydrogen peroxide.

4. *How can chromic acid contamination be removed from a dull nickel solution?*

Ans. Add sufficient ferrous sulphate to neutralize chrome adjust pH to 5.8 with nickel carbonate. Filter and readjust pH. The chrome can be determined with diphenylcarbozone.

5. *How does tri-valent chrome affect a chrome plating solution? How can it be removed?*

Ans. It decreases the bright plating range, reduces conductivity, produces a soft plate. It may be removed by suspending a cathode inside a porous cup in the solution and working for a long period.

6. *How can pitting on the underside of flat work being hard chrome plated be prevented?*

Ans. Agitate work or solution to wash bubbles away.

7. *What is the formula for a chromic acid bright dip for cadmium?*

Ans. This solution is patented.

8. *What is meant by "burning in" a polishing wheel when it is set up?*

Ans. This operation is of no known benefit and it not advised.

Newark Branch

1. *Can chromium be plated successfully on silver?*

Ans. The deposit will not be bright, but can be buffed if a heavy deposit of chromium is applied. Temperature of solution should be 115°F. to 120°F.; current density about 130 amperes per square foot.

GEORGE WAGNER, *Secy.*

Chicago Branch

1. *What causes pitting on silver plated articles? Base metal brass, nickel plated and buffed prior to silver plating, this pitting occurs on the one side or edge nearest the anodes.*

Ans. Many suggestions offered, but it was thought that the use of a silver strike before silver plating and reducing the current in the silver tank would overcome this pitting.

2. *How can a brass solution having a ratio of 40 to 1 copper plate a yellow brass?*

Ans. The color is obtained by use of too much ammonia or caustic. This solution should be balanced by the right amount of metals rather than trying to control the color with chemicals.

J. W. HANLON, *Secy.*

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The Colonial Alloys Company of Philadelphia, Pa., has, among other processes for treating aluminum base alloys, a non-electrolytic method of oxide coating. *Unlike* anodizing, the process requires no electrical equipment and no special racking. Small parts can be done in mass and the time element is much shorter than anodizing. The oxide coat is highly glazed, indicating the unusual density of this protective formation.

Also *unlike* anodizing, the cost is very low, the solution is harmless, non-toxic and does not require special equipment. While the oxide coat does not lend itself to a full range of coloring it can be colored with di-chromate solutions or others, both for decorative or protective effect. The oxide coat produced by this method is unusually corrosion resistant having consistently withstood over 2500 hours of 20% salt spray. The coat is not as hard as anodizing, but has excellent abrasion resistance.

As a base for paint, this treatment is excellent. Bending, hammering, twisting, moisture, heat and other factors injurious to paint adhesion do not affect finishes on these oxide coats. The process consists of immersing the aluminum base alloy into the heated solution for from 5 to 15 minutes, depending on the alloy. The work is then either sealed in hot water, dichromate solution, silicate, wax or painted. The material for the bath is sold under license by the COLONIAL ALLOYS COMPANY, Philadelphia, Pa.

Among some of the other processes marketed by this company are anodizing by A.C. Current at 20 Volts, electroplating aluminum base alloys, alkaline bath for direct current anodizing, and soldering and brazing processes for aluminum base alloys.—JOSEPH STEEL, Colonial Alloys Company.

SIMPLE METHODS OF ANALYZING PLATING SOLUTIONS

A new edition (the sixth) of a forty-eight page booklet giving in detail, simple and practical methods of analyzing plating solutions has been published by the Hanson-Van Winkle-Munning Co. This work has now been in circulation since 1930 and has become one of the standard textbooks in its field. The methods recommended are simple and highly practical in character, and can be applied by men without extensive chemical training.

The contents of the book include descriptions of the principles involved in analysis, the use of apparatus, the method of sampling a plating solution and step-by-step methods for the complete analysis of the following solutions: Nickel, Black Nickel, Silver, Sulphate Copper, Cyanide Copper, Rochelle Copper, Cyanide Brass, Cyanide Gold, Cyanide Zinc, Sulphate Zinc, Chromic Acid, Alkaline Tin, Cyanide Cadmium, H-VW-M Bright Cobalt Nickel, H-VW-M Semi-Bright Nickel. The book is thoroughly indexed making it easy to find the particular alanysis desired.

Full lists are given of the necessary equipment and chemicals required for the analytical work. The book contains a number of valuable reference tables covering: component parts in percent by weight, of salts commonly used in electroplating; densities of commercial acids; electro-motive series; sodium cyanide required to dissolve metal salts; acid and alkali actions on metals; electro-chemical equivalents.

A new section is included, Electrochemical Data for the Important Metals, which gives the usual cathode efficiencies; average cathode current densities; ampere minutes per sq. ft. to deposit 0.0001″ at the usual efficiency; the time in minutes required to deposit 0.0001″ at the average cathode current density and the usual cathode efficiency; all of these data for a number of the most important plating solutions. A detailed description is given, with examples, of methods of determining the thickness of deposits at various plating times and current densities. Another useful table gives the factors for the conversion of weights of metals into thickness and vice versa.

Copies of this book are obtainable on request from the Hanson-Van Winkle-Munning Co., Matawan, N. J. It is noteworthy that this company also places its laboratory at the full service of all electroplaters for instruction and consultation.

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The Abstract Section

CHARLES C. CONLEY, *Chairman, Program and Educational Committee*

General Principles and Methods of Electroplating. By W. BLUM, A. O. BECKMAN, and WALTER R. MEYER. *Trans. Electrochem. Soc.* **80** (Preprint 33) (1941). **Solutions.** Plating solutions may be classed as acid, neutral (pH 2-8), or alkaline. As to the constitution of solutions, there is still no adequate theory; in particular, the compounds existing in cyanide baths remain unknown. So also, there is no adequate explanation of the mechanism of electrodeposition nor of the effects of addition agents, which are of increasing importance for bright plating baths. Many of the newer addition agents are not colloidal in nature. To be acceptable, any theory must account for (1) the inclusion in the deposit of the addition agent or derivatives from it, (2) the effect on the structure and properties of the deposit; and (3) the effect on the cathode polarization. The addition agent may be included in the deposit mechanically by entrapment or by selective adsorption by the deposit, or by the electrical discharge and deposition of colloidal particles, or of complex cations. Investigation in this field remains largely empirical.

Distribution of deposits. With the adoption of minimum thickness specifications, as uniform a distribution of the metal deposit as possible has become very desirable. The deposit distribution depends on (1) the variation of cathode efficiencies at the current densities involved, and (2) the distribution of the current, which in turn is governed by (*a*) the shape and dimensions of the cathodes, anodes and tank, and (*b*) the polarization. Unless the effects of these factors are all in the same direction, it is impossible to predict what a change in operating conditions will do to the metal distribution, or throwing power; a certain change may produce more uniform distribution on one object, but less uniform distribution on another object of a different size and shape. There are generally certain critical spacings between the anodes and cathodes, and between the several cathodes, giving the maximum uniformity of deposit distribution; beyond these spacings, the uniformity is not increased. "Throwing power is not a single measurable property of the solution," and measurements with "boxes" or articles of any certain shape, as bent cathodes, are not necessarily applicable to articles of different shapes. In this connection, the "covering power" and "plating range" are also significant.

Maintenance of baths. The factors changing the bath compositions during operation are (*a*) dragout, (*b*) inequalities between anode and cathode efficiencies, usually accompanied, in neutral baths, by an equivalent change in pH, (*c*) introduction of impurities, dissolved or suspended, from anodes, unplated cathodes, added chemicals and water, racks, or dust. Dragout depends on the viscosity of the solution, the surface tension, the shape and position of the pieces being plated, the time required for withdrawal and draining, and the number of pieces removed per hour. It may be compensated for by the use of "recovery rinses." Agitation helps to keep the bath uniform, and by replenishing the dissolved metal at the cathode surface, permits a higher

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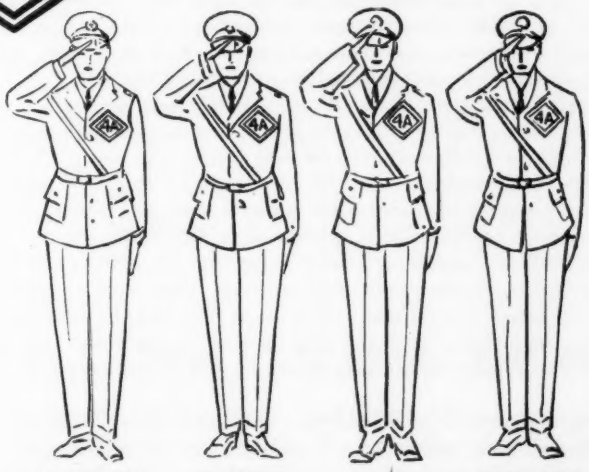

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current density; the movement should be equivalent to at least 10 ft. per minute, and may be obtained by moving the cathode, circulating the solution, or, in certain baths, using air jets. Filtration removes suspended impurities, and is often of value for dissolved impurities, since these frequently may be precipitated. Of the latter, metals, dissolved as salts, may be deposited by electrolysis at low current densities, or by displacement on a less noble metal, or they may be precipitated either as sulfides in cyanide baths, or as hydroxides or basic salts in neutral baths (by raising the pH); objectionable anions, as carbonate in cyanide solutions, are partially removed by freezing or precipitation; while organic compounds, which are often colloidal, are eliminated by oxidation, or by adsorption on inorganic precipitates or activated charcoal. Although the amount of suspended material to be removed is small, large capacity filters are preferred to provide space for "filter aids" and charcoal.

Control of bath temperatures. Chromium, bright nickel, and some other baths require close temperature control, often automatic, applied to heating coils and sometimes cooling coils or heat exchangers.

Materials of construction. Wood is widely used for rinse tanks, steel for alkaline solutions, lead-lined tanks for baths containing sulfuric or chromic acids, and rubber-lined steel tanks for acid and neutral baths. Various synthetic stop-off materials are available for covering portions of plating racks.

Current sources. Plating motor-generator sets are manufactured by a small number of manufacturers specializing in this field; sizes up to 25,000 amps are available, and show efficiencies greater than 80%. Rectifiers, of the copper oxide, copper sulfide, and selenium types, have recently become available; although less efficient at full loads, they may be advantageous for intermittent or variable loads, and they have no moving parts; they have not been in service long enough to permit estimates of life or comparative usefulness.

Testing and control of solutions. Periodic chemical analyses of baths has greatly increased, particularly to assist in meeting plating specifications. Methods sufficiently rapid, reliable, and simple enough to be applied by persons with only elementary chemical training, are available for most determinations.

pH. "The introduction of the term 'pH' by Sorensen in 1909 materially aided the practical application of hydrogen ion measurements in industry by providing a simple numerical scale to replace the inconvenient negative exponents required when hydrogen ion concentrations are expressed in mils (or grams) per liter." Colorimetric methods, by which the pH is estimated from the effect of the solution on the color of a sensitive dye, or "indicator," are simple and inexpensive, but subject to inaccuracies which limit seriously their usefulness. Electrometric methods determine the electric potential between certain pairs of electrodes which respond suitably to the pH of the solution in which they are immersed. The standard electrode is the hydrogen electrode, but it is so inconvenient, slow, and easily poisoned that it is impractical for general use. The quinhydrone electrode is rapid and suitable where the pH does not exceed 8.5, and the solution contains no substances reacting with quinhydrone. The antimony electrode is less reliable and is not much used. The glass electrode, though more costly, is the most rapid and

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adaptable instrument; it is not subject to interference from any substance except when the pH is less than 1, in which case direct titration of the acid is generally preferable for other reasons and when the pH exceeds 10, where it is influenced by sodium salts; however, for the latter case special electrodes are available which show almost no error. Since a glass electrode sufficiently rugged for industrial use will conduct only a tiny current, a vacuum tube amplifier is required to operate suitable indicating meters. A circuit diagram is given, and requirements of insulation and shielding are considered. The effect of temperature, liquid junction potentials, and the significance of pH in plating baths are explained. The exposition of pH and the glass electrode is one of the most exhaustive and informative reviews on this subject in electroplating literature.

Surface Tension. Stalagmometer or tensiometer measurements are employed chiefly for determining the wetting agent in bright nickel baths.

Thickness of deposits. "The thickness of electroplated coatings is the most important single factor in their resistance to wear and corrosion." The loss of weight on stripping the deposit gives the *average thickness*, which, however, has been replaced in most specifications by the more important *minimum thickness* on significant surfaces. For determining local thicknesses, the microscopic, chord, and magnetic methods are briefly described, as well as several chemical tests, such as immersion, spot, dropping, and jet tests.

Adhesion. Factors governing adhesion and various tests for this property are discussed, although "it is unlikely that any simple test for the quantitative measurement of the adhesion of coatings on finished articles can be developed."

Protective value. The value of zinc and cadmium coatings is proportional to their thickness; in rural or marine atmospheres, a thin coating (0.0002″) furnishes considerable protection, but in industrial atmospheres, zinc and cadmium are more rapidly attacked, with cadmium coatings failing earlier. As copper, nickel, and chromium are not rapidly attacked, the thickness of these coatings is significant largely as the best way to reduce porosity, which must be low for good resistance. Heavy coatings are required except for chromium, which has an optimum thickness at about 0.00003″. Porosity is tested by the salt spray, although the significance of the results is not clear, by the ferroxyl test, or by the hot water test; in no case are quantitative measurements reproducible. On brass, copper and nickel furnish better protection than on steel. On zinc-base die-castings, about as much nickel is required as on steel; a copper undercoat is generally employed as nickel deposition direct on zinc is difficult; on such articles, the salt spray test is useful to detect pores in the coatings.

Physical properties of deposits. Measurements of tensile strength, elastic limit, elongation, hardness, reflecting power, and brightness are important but difficult; various methods are discussed. A table of hardnesses of various electroplated metals is given, with some explanations of the results.

Structure of deposits. "Electrodeposited metals are characterized, in general, by relatively high hardness, lower ductility, greater anisotropy, lower propensity toward recrystallization and frequently finer grain size than metals prepared by normal metallurgical means." Descriptions of crystalline condition in plating literature are loose and confusing, referring often to the ap-

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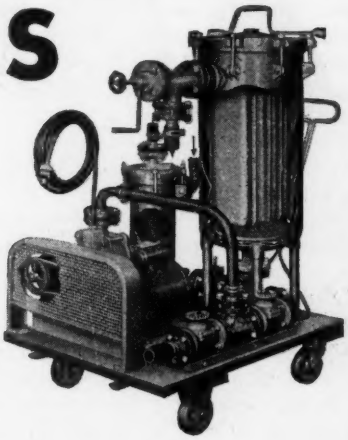

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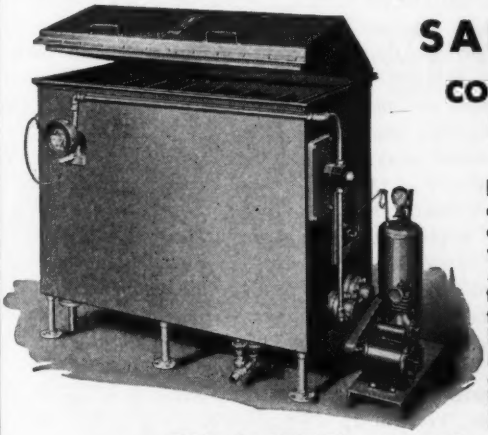

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pearance of the surface rather than to actual knowledge of the internal structure. "Electrodeposits may be one-phase metal deposits, metallic compounds, solid solutions, or two or more separate phases." Many electrodeposits, as nickel, iron, copper, and zinc from simple solutions, are predominantly columnar in structure, and the grains are large enough to be seen readily under the microscope. Other deposits, as chromium, and copper, cadmium, and silver from cyanide baths, have no resolvable structure under the microscope. Bright nickel deposits are usually banded. Often a preferred orientation of crystals is found. Indications that considerable stress occurs in electrodeposits, and recrystallization phenomena are considered.

Factors affecting deposits. The influence of the basis metal is described, particularly as relates to scratches, cracks, holes, loose particles, projections, polishing marks, etc., which affect the smoothness, porosity, and pitting, and thus the corrosion resistance of the plate. The reproduction of the structure of the basis metal in the electrodeposit is reviewed, together with the effects of the type and condition of the plating solution, and the current density.

Bright deposits. Contrary to former opinions, smallness of grain size is not the only factor in a bright deposit; the degree of orientation is at least as important. A relatively coarse-grained deposit may be bright if the crystals have essentially parallel faces. Bright deposits are frequently banded. Theories of the action of addition agents are reviewed.

ERNEST H. LYONS, JR.

Developments in connection with the Bullard-Dunn pickling process. JOHN KRONSBEIN. *J. Electrodepositors' Tech. Soc.*, Vol. **16,** pp. 55-60 (1940). The Bullard-Dunn process consists in descaling steel articles by making them cathodic at 60-80 amp./ft.^{2} in a hot dilute H_2SO_4 solution, containing 1 g./1. (0.13 oz./gal.) of tin sulfate. Wherever scale is removed, tin is deposited. The deposit does not become very thick because after the steel is once covered, the additional deposit becomes spongy. The tin coating protects the cleaned areas from further attack by the acid, and the high hydrogen overvoltage on tin reduces the current density on the plated areas. The hydrogen embrittlement resulting from the B-D process is only temporary. Measurements of the transverse breaking loads of steel bars showed that the embrittlement disappears after 1 to 14 days at room temperature, or after 2 hrs. treatment at 212°F. Although the tin coating deposited on the cleaned surface is thin, it is sufficient to prevent corrosion during storage. Accelerated and atmospheric tests were made of painted steel specimens, of which some had not been pretreated and others had been pretreated by (1) shot-blasting and parkerizing, (2) B-D cleaned (tin not removed). The specimens prepared by the latter process showed more corrosion resistance than the others.

A. BRENNER

Factors in the production of perfect nickel plating. S. WERNICK. *J. Electrodepositors' Tech. Soc.*, Vol. **16,** pp. 35-44 (1940). A good Ni deposit should possess the following qualities: good adhesion to base metal; nonporosity, freedom from pits, inclusions, or blisters; ductility and uniformity. Alkali cleaners are discussed in general. Cleaners made up with hard water may leave precipitates on the work. Sodium hexametaphosphate (0.8 oz./gal.) is used to prevent formation of a precipitate, and it may also be used in a still

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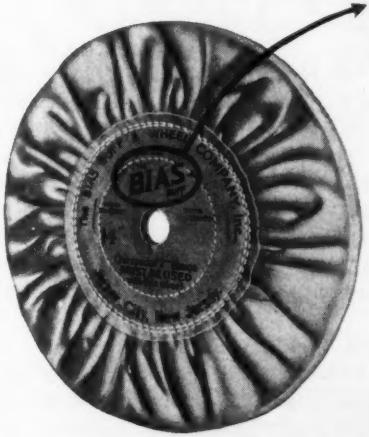

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rinse, which latter is followed by a running rinse. Anodic etching of steel is recommended to secure good adhesion. Addition of a wetting agent, such as iso-propyl naphthalene sulphonic acid ester (0.3 to 0.7 oz./1000 gal.), will prevent pitting in a nickel bath. Rough deposits result from particles in the bath which may come from dust which originates in the polishing room, ventilating fans, generator brushes, etc. The amount of particles given off by anodes is reduced by use of carburized anodes. These form a carbon film when in use which helps to retain anode particles. Racks and racking materials are also a source of bath contamination. A. BRENNER

The technique of filtering plating solutions. S. WERNICK and H. SILMAN. *J. Electrodepositors' Tech. Soc.*, Vol. **16,** pp. 99-114 (1940). Clear plating baths are essential for the production of pore free deposits. The following types of filters are discussed: filter cone, filter press, filter candle, precoated filter, and centrifugal filter. The filter press is not satisfactory for plating baths because of its tendency to leak, and because of the labor involved in cleaning and reassembling. Candle filters are tubes made from Kieselguhr, compressed and fired. They give good filtration, but have the disadvantage of a low output of filtered solution because of clogging of filtering surface, and equire a large amount of labor for disassembling and cleaning. Filters precoated with Kieselguhr seem most satisfactory for plating baths. For a filter base, the British use a type of filter candle built up by stacking a large number of thin flat washers together on a slotted rod. American practice utilizes wood or ebonite grids covered by cloth or wool bags. The centrifugal filter gives good results, but an installation large enough to give the rate of output required for a plating bath would be rather expensive. When continuous filtration is used, from 25% to 100% of the volume of the tank should pass through the filter each hr. On filter installations, a pressure gage and a rotameter are useful to indicate the performance of the unit. Activated charcoal is recommended for removing organic contaminants from baths. Other subjects discussed are: anode bags, filter pumps, and removal of impurities from plating baths. A BRENNER

Finishing The Bell Airocaberas. By JOHN W. WELTY, *Metal Finishing*, October 1941, Page 549. Author discusses materials used in the construction of the Bell Airacobera, methods for finishing these metals as well as the specifications followed are given. This paper includes chrome pickling, cadmium, plating, anodizing and enameling. Methods employed for control and analysis of solutions are also given. Titration curves are also given.

Prevention of Nodules and Porous Nickel Coatings. By ROBERT J. GREEN. *Metal Finishing*, October 1941, Page 559. Author emphasizes the importance of removing finely divided impurities and dirt from nickel solutions where non-porous deposits are desired.

Surface Active Materials in Acid Pickling Solutions. By D. S. HARTSHORN, JR. *Metal Finishing*, October 1941, Page 561. This article discusses the advantages of surface active materials (wetting agents) in acid pickling solutions. The following advantages are cited: More uniform pickling, savings in acid through decreased dragout losses, and inhibiting action, reduction of fumes and spray, and emulsification of oil films.

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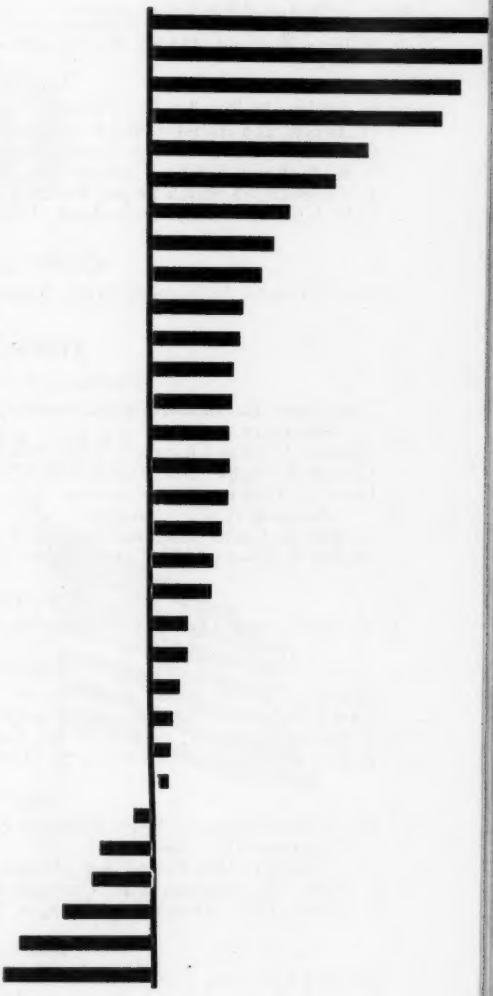
MEMBERSHIP CAMPAIGN REPORT

BRANCH	May 1, 1941	Change in Membership	Percent Change
Balt.-Washington	43	+11½	+26.7
Hartford	48	+12	+25.0
San Francisco	38	+8	+21.1
Toronto	66	+13	+19.7
Dayton	79	+13	+16.5
Montreal	29	+4	+13.8
Bridgeport	72	+7½	+10.4
Pittsburgh	43	+4	+ 9.3
New York	121	+10	+ 8.3
Toledo	44	+3	+ 6.8
Los Angeles	121	+8	+ 6.6
Newark	136	+8½	+ 6.3
Buffalo	49	+3	+ 6.1
Boston	102	+6	+ 5.9
Grand Rapids	77	+4½	+ 5.8
Prov.-Attleboro	44	+2½	+ 5.7
Waterbury	87	+4½	+ 5.2
Detroit	260	+12	+ 4.6
Rochester	76	+2	+ 2.6
Indianapolis	39	+1	+ 2.6
Chicago	234	+5	+ 2.1
New Haven	100	+1½	+ 1.5
Cleveland	80	+1	+ 1.3
Milwaukee	92	+1	+ 1.1
St. Louis	79	—1	— 1.3
Anderson	40	—1½	— 3.8
Binghamton	22	—1	— 4.5
Lancaster	44	—2	— 4.5
Cincinnati	53	—3½	— 6.6
Springfield	69	—7	—10.1
Philadelphia	150	—17	—11.3



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MEMBERSHIP — Dec. 1st, 1941 = 2650
GAIN IN MEMBERSHIP 113
GAIN = 4.5%

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DECEMBER 1941

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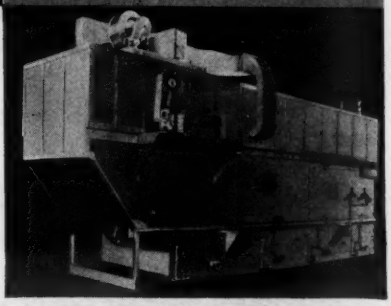

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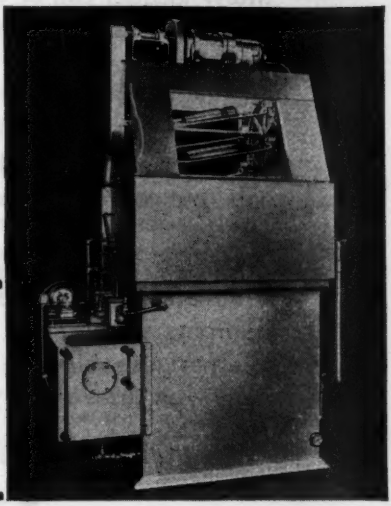

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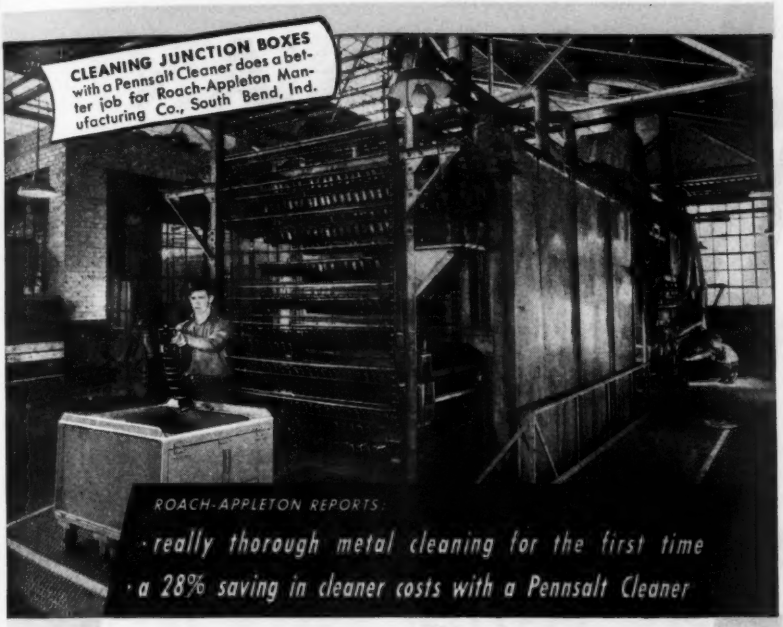
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"Our Pennsalt Cleaner is the only product that really does a thorough job for us in cleaning electrical junction boxes, made of low carbon steel, prior to plating or enameling. Also, we formerly used two different metal cleaners, one for cleaning the junction boxes to be enameled, the other to clean those to be plated. Now we do both jobs better with this one Pennsalt Cleaner . . . and on top of that, it has saved us 28% in cleaner costs."

THE RIGHT METAL CLEANER FOR YOU is the Pennsalt Cleaner with the properties best suited to your specific conditions. Let one of our experienced technical men help you choose the most efficient metal cleaner for your needs. Write us about your problems today . . . to our Pennsalt Cleaner Division, Dept. MR.

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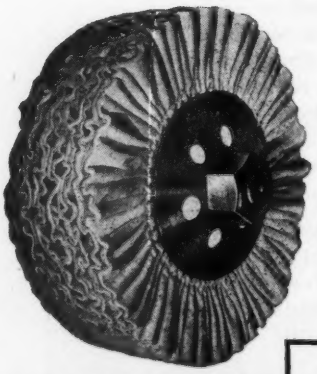

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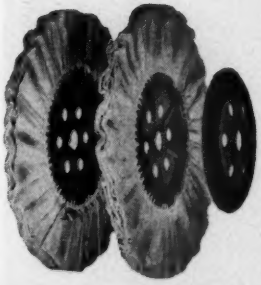

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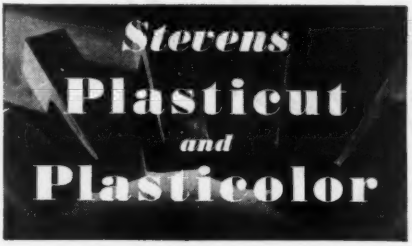

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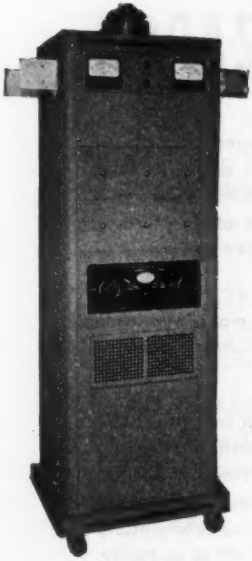

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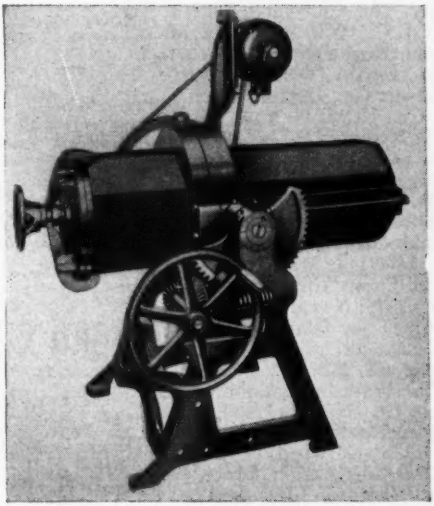

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Meaker Company, The, Chicago, Ill.
Munning & Munning Inc., Newark, N. J.
Packer Machine Co., The, Meriden, Conn.
Stevens, Frederic B., Inc., Detroit, Mich.
Storts Welding Co.. Meriden, Conn.
Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit, Mich.
Wagner, A. T., Co., Detroit, Mich.

Lead Lined Tanks

Belke Mfg. Co., Chicago, Ill.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Lasalco, Inc., St. Louis, Mo.
Storts Welding Company, Meriden, Conn.
Udylite Corp., The, Detroit, Mich.

Meaker Process Galvanizing

Meaker Company, The, Chicago, Ill.

Metal Lacquers and Finishes

Atlas Powder Co., Zapon Div., Stamford, Conn.
Egyptian Lacquer Mfg. Co., New York City
Maas & Waldstein Co., Newark, N. J.

Metal Working Lubricants

Magnus Chemical Co., Garwood, N. J.
Oakite Products, Inc., New York City

Oxidizing Agents

Lasalco, Inc., St. Louis, Mo.
Sulphur Products Co., Greensburg, Pa.

pH Papers

Hanson-Van Winkle-Munning Co., Matawan, N. J.
Harshaw Chemical Co., The, Cleveland, Ohio
Lasalco, Inc., St. Louis, Mo.
Lea Mfg. Co., The, Waterbury, Conn.
Munning & Munning, Inc., Newark, N. J.
Udylite Corp., The, Detroit, Mich.

Plating Barrels

Belke Mfg. Co., Chicago, Ill.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Lasalco, Inc., St. Louis, Mo.
Lea Mfg. Co., The, Waterbury, Conn.
Munning & Munning, Inc., Newark, N. J.
Stevens, Frederic B., Inc., Detroit, Mich.
Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit, Mich.
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Munning & Munning, Inc., Newark, N. J.
Stevens, Frederic B., Inc., Detroit Mich.
Storts Welding Co., Meriden, Conn.
Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit, Mich.
Wagner, A. T., Co., Detroit, Mich.

Polishing Lathes

Baker, M. E., Co., Cambridge, Mass.
Belke Mfg. Co., Chicago, Ill.
Divine Brothers Co., Utica, N. Y.
Gumm, Frederick, Chemical Co., Inc., Kearny, N. J.
Hammond Machinery Builders, Kalamazoo, Mich.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Lasalco, Inc., St. Louis, Mo.
L'Hommedieu, Chas. E., & Sons Co., Chicago, Ill.
Siefen, J. J.. Detroit, Mich.
Stevens, Frederic B., Detroit, Mich.
Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit. Mich.
Wagner, A. T., Co., Detroit, Mich.

Polishing Wheels and Materials

Baker, M. E., Co., Cambridge, Mass.
Belke Mfg. Co., Chicago, Ill.
Bias Buff and Wheel Co., Inc., Jersey City, N. J.
Burns, E. Reed, Brooklyn, N. Y.
Divine Brothers Co.. Utica, N. Y.
Formax Mfg. Co., Detroit, Mich.
Gumm, Frederick, Chemical Co., Inc., Kearny, N. J.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Lasalco, Inc., St. Louis, Mo.
L'Hommedieu, Chas. E., & Sons Co., Chicago, Ill.
Matchless Metal Polish Co., The, Glen Ridge, N. J., and Chicago, Ill.
Roberts Rouge Co., Stratford, Conn.
Siefen, J. J., Detroit, Mich.
Stevens, Frederic B., Detroit, Mich.
Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit. Mich.
Wagner, A. T . Co., Detroit. Mich.

Rouges

Bias Buff & Wheel Co., Inc., Jersey City, N. J.
Formax Mfg. Co., Detroit, Mich.
Hanson-Van Winkle-Munning Co.. Matawan, N. J.
Harrison & Co., Haverhill, Mass.
Lasalco, Inc.. St. Louis, Mo.
Roberts Rouge Co., Stratford, Conn.
Stevens, Frederic B., Detroit, Mich.
Udylite Corp.. The, Detroit, Mich.

Rubber-Lined Tanks

Belke Mfg. Co., Chicago, Ill.
Lasalco Inc.. St. Louis, Mo.
Storts Welding Co., Meriden, Conn.
Wagner A. T Co. Detroit Mich

Used Equipment

Baker, M. E. Co., Cambridge, Mass.

Soaps

Hanson-Van Winkle-Munning Co., Matawan, N. J.
Lea Mfg. Co., The. Waterbury, Conn.
MacDermid, Inc., Waterbury, Conn.
Magnus Chemical Co., Garwood, N. J
Magnuson Products Corp., Brooklyn N.Y.
Oakite Products, Inc., New York City
Udylite Corp.. The, Detroit, Mich.

Solution Control Methods

du Pont, E. I., de Nemours & Co., Inc. Wilmington, Del.
Hanson-Van Winkle-Munning Co. Matawan, N. J.
Lasalco, Inc., St. Louis, Mo.

Solvents—Degreasing

A.B.C. Chemical Co., Waterbury, Conn.
Detroit Rex Products Co., Detroit, Mich.
Lasalco, Inc., St. Louis, Mo.
Lea Mfg. Co.. The. Waterbury, Conn.
MacDermid, Inc., Waterbury, Conn.
Wagner, A. T., Co., Detroit, Mich.

Solvents — Recovered

A.B.C. Chemical Co., Waterbury, Conn.

Stripping Compounds

Detroit Rex Products Co., Detroit, Mich.
du Pont, E. I., de Nemours & Co., Inc., Wilmington, Del.
Gumm, Frederick. Chemical Co., Inc., Kearny, N. J.
MacDermid, Inc., Waterbury, Conn.
Magnuson Products Corp., Brooklyn, N.Y.
Oakite Products, Inc., New York City
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.

Testing Instruments

du Pont, E. I., de Nemours & Co., Inc., Wilmington, Del.
Harshaw Chemical Co., The, Cleveland, Ohio
Industrial Filter & Pump Mfg. Co., Chicago, Ill.
Kocour Co., Chicago, Ill.
Lasalco, Inc., St. Louis, Mo.
Wagner, A. T , Co., Detroit, Mich.

Tumbling Barrels

Abbott Ball Co., Hartford, Conn.
Baker, M. E., Co., Cambridge, Mass.
Belke Mfg. Co., Chicago, Ill.
Lasalco, Inc., St. Louis, Mo.
Storts Welding Co., Meriden.Conn.
Wagner. A. T., Co., Detroit, Mich.

Udylite Cadmium Service

MacDermid Inc., Waterbury, Conn.
Udylite Corp., The, Detroit, Mich.

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